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SUSTAINABILITY-BASED STRATEGIC DECISION MAKING IN PRODUCT AND SERVICE DEVELOPMENT

Master of Science Thesis

Examiner: Professor Miia Martinsuo
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ABSTRACT

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Decision making in product and service development deals with which concepts are developed, which markets are targeted, and what kinds of benefit expectations are directed at the product or service. Previous research has focused on various strategic, technical, market and commercial dimensions of evaluation mainly as part of product development decisions. Increasingly, however, product and service development requires that sustainability is taken into account as early as possible. Previous research has not sufficiently tackled sustainability as part of development decision making, or the unique features of service and system development decisions.

This thesis explores how companies can develop their sustainability-based strategic decision making as part of product and service development activities. The objective is increased understanding on the ways in which companies embed sustainability into their decision making and information search. After the introduction, an extensive literature review is presented on sustainable business and how it influences decision making in product and service development. The business model is discussed at length with the focus on influences of sustainability and on new product and service development. Then, the results that were obtained from semi-structured interviews with three case companies are presented.

The study indicates that companies can develop their sustainability-based strategic decision making and enable the creation of sustainable business by developing a consistent strategy that places sustainability to the core of operations. Consistent implementation was found to be just as important. In all cases the strategy and implementation took the form of anticipating tightening regulation, then developing capabilities to efficiently comply before other companies and then selling and marketing those offerings to prospective customers. The study found several factors that need to be considered when seeking to the take sustainability better into consideration in the implementation. These factors were task-, decision maker-, elicitation- and aggregation-related.

TIIVISTELMÄ

TAMPEREEN TEKNILLINEN YLIOPISTO
Tuotantotalouden koulutusohjelma
ARVIO, ILKKA: Kestävän kehityksen mukainen strateginen päätöksenteko tuote- ja palvelukehityksessä
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Päätöksenteko tuote- ja palvelukehityksessä ottaa huomioon sen, mitä konsepteja kehitetään, mille markkinoille tähdätään ja millaisia hyötyjä kehitettävältä tuotteelta tai palvelulta odotetaan. Aikaisempi tutkimus on keskittynyt erilaisiin strategisiin, teknisiin, markkinakohtaisiin ja kaupallisiin ulottuvuuksiin, jotka ovat osa päätöksiä tuotekehityksessä. Lisääntyvässä määrin kuitenkin tuote- ja palvelukehitys vaatii, että kestävä kehitys otetaan huomioon mahdollisimman aikaisessa vaiheessa. Aikaisempi tutkimus ei ole riittävässä määrin perehtynyt kestävään kehitykseen osana kehityksen päätöksentekoa, tai palvelu- ja systeemikehityksen erityispiirteisiin.

Tämä työ tutkii, miten yritykset voisivat kehittää kestävän kehityksen mukaista strategista päätöksentekoa osana tuote- ja palvelukehitystä. Tämän työn tavoite on saavuttaa suurempi ymmärrys tavoista, joilla yritykset voivat sisällyttää kestävän kehityksen päätöksentekoonsa ja tiedonhakuunsa. Johdannon jälkeen työ esittää laajan kirjallisuuskatsauksen, jossa kestävän kehityksen liiketoiminta ja sen vaikutukset päätöksentekoon tuote- ja palvelukehityksessä käydään läpi. Liiketoimintamalli esitellään laajasti ja tässä fokus on vaikutuksilla kestävään kehitykseen ja kehitystoimintaan. Tämän jälkeen tulokset, jotka saatiin kolmea tapausyritystä haastattelemalla, käydään läpi.

Tulokset viittaavat siihen, että yritykset voivat kehittää kestävän kehityksen mukaista strategista päätöksentekoa ja mahdollistaa kestävän kehityksen mukaisen liiketoiminnan syntymistä formuloimalla yhtenäisen strategian, joka asettaa kestävän kehityksen toimintojen ytimeen. Johdonmukaisen implementoinnin havaittiin olevan aivan yhtä tärkeää. Kaikissa tapauksissa strategia ja sen implementointi alkoivat ympäristösääntelyn ennakoinnista, minkä jälkeen yritykset kehittivät kyvykkyyksiä mukautuakseen tähän sääntelyyn ennen muita yrityksiä ja sitten myivät ja markkinoivat näitä kyvykkyyksiä mahdollisille asiakkaille. Tutkimus löysi useita tekijöitä, jotka pitää ottaa huomioon, kun kestävä kehitys halutaan ottaa paremmin huomioon implementoinnissa. Tekijät liittyivät tehtävään, päätöksentekijään, toteutukseen ja yhdistelyyn.

PREFACE

I am very grateful to prof. Martinsuo for giving me the opportunity for this thesis and for all the support that I needed during this year, my wife Anne for making many big sacrifices for me that can be directly attributed to this thesis and my parents for instilling in me the will to never give up. I also found the group of researchers in StraSus very enjoyable to work with. Them I would like to thank for supporting the data collection in many ways.

Tampere 27.7.2014

Ilkka Arvio

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TERMS AND DEFINITIONS

PSS	Product-Service System
EMS	Environmental Management System
NPD / NSD	New Product Development / New Service Development

1. INTRODUCTION

1.1 Background

We are living in interesting times. As competition for natural resources intensifies, sustainability will rise to the top of the company agenda once again. For this reason the decoupling human progress from resource use and environmental decline can be one of the biggest sources of future success if companies focus on solving these issues. Resource efficiency creates a business case that supports consumption of local materials, fuels and human resources (BCG & INSEAD, 2012). Companies that excel within this new paradigm of competitive advantage can turn this constraint into an opportunity and gain market share. Those that fail to respond to this trend will suffer from price increases and volatility, regulation and social pressures, which is illustrated in Figure 1.

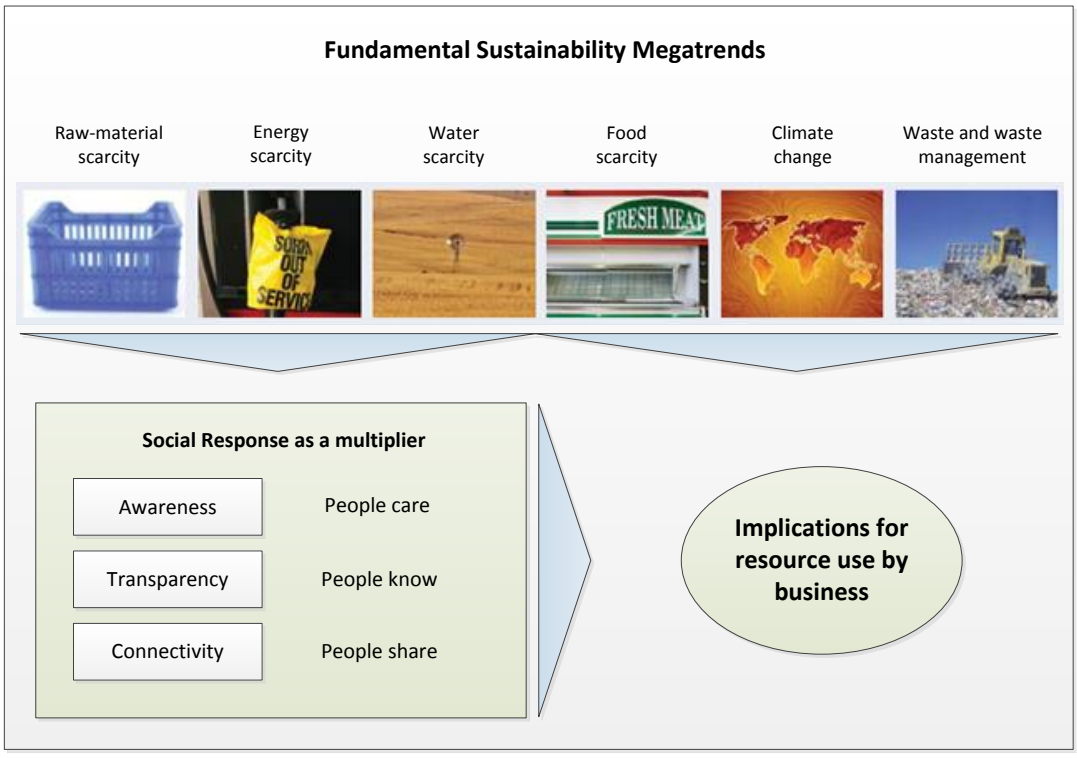

Figure 1: Megatrends directly affect business – and are amplified through society's response. (BCG & INSEAD, 2012)

Radical system change to improve resource efficiency involves a reconfiguration of operational practices. The challenge is to introduce management strategies and procedures that replace the perception of 'sustainability is a cost to the company' to 'sustain-

ability as a driver of profits' and to 'achieving growth through resource efficiency'. Lowering resource consumption has been shown to be an efficient method of adding shareholder value through the reduction of short term operational expenditure and the reduction of exposure to long term environmental risk (Lovins & Cohen, 2011). Therefore financial benefit can even be the primary motive through resource efficiency and the ensuing reduction in environmental impact can be considered as an additional benefit. It has been observed that sustainability is an especially important topic for resource intensive industries (McKinsey Global Institute, 2012).

Researchers studying the interface of environmental performance and business performance often neglect the ways in which companies shift the focus of their R&D capabilities, reorganize their innovation processes around new techniques and inputs, collaborate with other industrial sectors and stakeholders, and build markets around new definitions of sustainability (Iles & Martin, 2013). One approach to developing more applied theory is to focus on the genesis and adaptation of business models (Boons & Lüdeke-Freund, 2013). Whereas a business strategy is concerned only with how a firm will compete, a business model focuses attention on the "core logic" underlying how various 'activity systems' in the company can fit together to deliver value to its customers and suppliers (Magretta, 2002). Many see the different Product-Service System (PSS) business models as excellent vehicles to enhance competitiveness and to foster sustainability simultaneously (Tukker, 2004). An important additional dimension is the dynamics between customer demand and the PSS offerings (Anttonen et al. 2013).

1.2 Research Questions

Sustainability-based strategic decision making has not received too much attention in product and service development. Strategic decision making in product and service development deals with which concepts are developed, which markets are targeted, and what kinds of benefit expectations are directed at the product or service. Previous research has focused on various strategic, technical, market and commercial dimensions of evaluation mainly as part of product development decisions. The focus there has been very benefit-centered as it deals almost solely with the project selection criteria and agreed procedures of the product and service development process. Increasingly, however, product and service development requires that sustainability is taken into account as early as possible. Previous research has not sufficiently tackled sustainability as part of development decision making, or the unique features of service and PSS development decisions (Boons & Lüdeke-Freund, 2013).

Business model and strategic decision-making are highlighted at the beginning of the development process, where the decisions have the most effect on the sustainability of

the solution. It is estimated that over 80% of all product-related environmental impacts are determined during the design phase of a product (European Commission, 2009). Due to the ability to drive system wide changes, the sustainability of a business model should be rigorously considered already at the beginning of the product and service development process and then guide how the development proceeds. The objective is increased understanding on the ways in which companies embed sustainability into their decision making and information search. Following this trail of thought, the main research question in this thesis is:

> *How can companies develop their sustainability-based strategic decision making as part of PSS development processes and enable the creation of sustainable business?*

To facilitate comprehensiveness and accuracy, the research question is broken into three sub-questions. Boons & Lüdeke-Freund (2013) state that empirical research is needed to shed light on the state-of-the-art of corporate sustainability management and sustainable innovation in daily business. They mention the case study approach in particular and need for research on what extent do firms consider the requirements for sustainable business models in their innovation practices be it process-, product-, or system-oriented. This leads to the first sub-question:

1. *What kind of requirements do sustainable business models set to strategic decision making in PSS development?*

In part, this question is currently taken into account in research on sustainable supply chain management. There is substantial literature on how supply chains are reorganized in the process of making them more sustainable (e.g., Boons and Mendoza, 2010; Seuring and Müller, 2008; Vermeulen and Seuring, 2009). However, it would be interesting to broaden the scope of the supply chain literature in such a way that instead of only the internal organization of the firm, the information exchange between all the functions of the firm is investigated. This leads to the second sub-question:

2. *How do companies process information in sustainable PSS development?*

Boons & Lüdeke-Freund (2013) point out that the business model concept is helpful in connecting insights at the different levels of analysis that have been identified in the context of sustainable innovation. Business models require a systemic perspective, but always from the viewpoint of how the firm can connect to, or build up, that system while delivering a certain value proposition. The issue often is to what extend do business models allow for sustainable system innovations, and how does this relate to business success. A related issue deals with the extent to which business models allow, or

hamper, specific types of innovations (e.g., Johnson, 2010). The third sub-question builds on these insights:

3. *How can companies incorporate sustainable value elements into their strategic decision making in PSS development?*

Because of the nature of the research gap and the scarce literature, this research will be explorative and will seek to look into the phenomenon through case studies. This research studies the case companies on the group level and focuses on the overview of their situation. Naturally, this research is constrained by the situation that the case companies are facing. One of the firms is actively pursuing the commercialization of a sustainable technology that it has developed to support other core activities. Another firm has a quite the opposing approach to PSS development. It has long-term experience in cultivating customer relationships and hopes to utilize this to uncover sustainability-based unfulfilled market needs that could be taken as a starting point for PSS development. Still, the purpose of this thesis is to explore how companies can develop their sustainability-based strategic decision making as part of product and service development activities. The objective is increased understanding on the ways in which companies embed sustainability into their decision making and information search. The case companies all operate in energy and heat production, but are not typical energy companies. The energy production is the connecting factor, but the companies are diversified far outside the energy industry.

1.3 Structure of the Thesis

This thesis is divided to six chapters. After the introduction, an extensive literature review is presented on sustainable business and how it influences decision making in PSS development. The chapter starts by defining two concepts: sustainability in a corporate context and product-service systems. Then business models are divided here into nine components and they are discussed at length with the focus on influences of sustainability and PSS on new product and service development. Additionally, the theoretical discussion on the value elements in sustainable business models is presented. Afterwards, strategic decision making is discussed and the discussion is linked to new product development. In the end of the chapter the whole theoretical discussion is synthesized and a framework is utilized to facilitate the research.

Chapter three describes the utilized research method in detail, introduces the case companies and describes the planned data collection and analysis. Many companies today are struggling to define and embed sustainability into their operations. This study will

focus on interviewing three case companies facing that situation. The interviews are semi-structured and focus on key informants on the group level. The chapter following that presents the results for every individual case company and utilizes a cross-case analysis to interact with the collected data. The results find important factors which influence sustainable decision making in development. These are task-, decision maker-, elicitation- and aggregation-related. The reported result for the individual case companies and also the cross-case analysis follows the outline which was developed based on the presented theoretical discussion in chapter two.

Chapter five goes into expanding on the results and analysis and additionally discusses the suitability of the chosen framework and some of the implications that the results point towards. It also presents the updated framework that is based on the results. Chapter six continues from that and summarizes the academic contribution, managerial implication and the limitations of the research in this thesis. Following that the references are reported and the developed interview outline is attached to the appendix.

1.4 The Context

This thesis is part of StraSus (Strategic business models and governance for sustainable solutions) research project, which is a TEKES funded project that explores how networked companies could improve their sustainability-based decisions as a part of their product and service development processes. The project creates new ways which support sustainable value creation, its measurement and validation in the networked business from the perspective of involved stakeholders, and over different life cycle phases of product-service systems.

The research will be carried out by VTT, Lappeenranta University of Technology, Tampere University of Technology and Aalto University in a coordinated co-operation with project's industrial partner companies. In addition to interviews, the industrial project partners will be involved in the project with company specific case studies to support project's development and testing phases. StraSus and in that context this thesis seek to provide guidance on sustainable business models and to assist companies acting as members of a broader network to embed sustainability into their products and services.

2. THEORETICAL BACKGROUND

2.1 The Concept of Sustainability in a Corporate Context

During its early years, the meaning of the term ‘sustainable development’ was ambiguous, leading to a wide array of definitions. Fortunately, that ambiguity has been clarified for the most part. This study employs the World Commission on Economic Development (WCED) definition, which is widely recognized today as the dominant one. Discussions in the literature have coalesced around the three principles that ground sustainable development: environmental integrity, economic prosperity, and social equity (Elkington, 1998; WCED, 1987). Each of these principles represents a necessary, but not sufficient, condition; if any one of the principles is not supported, economic development will not be sustainable. These principles are expanded below.

Environmental integrity, or environmental sustainability, as a principle ensures that human activities do not erode the earth's land, air, and water resources. Ecosystems are assumed to have limited regenerative capability and carrying capacity (IISD, 1995). Population growth, combined with excessive consumption, escalating pollution, and depletion of natural resources, threatens environmental integrity (Pearce, Markandya & Barbier, 1989; WCED, 1987).

Social equity, or social sustainability, as a principle ensures that all members of society have equal access to resources and opportunities. Central to the definition of sustainable development is the recognition that needs, present and future, must be met (WCED, 1987). Human needs not only include basic needs such as food, clothing, and shelter, but also include a good quality of life such as health care, education, and political freedom (IUCN, UNEP & WWF, 1996; UNCED, 1992).

Economic prosperity, or economic sustainability, as a principle promotes a reasonable quality of life through the productive capacity of organizations and individuals in society (Holliday et al., 2002). Economic prosperity involves the creation and distribution of goods and services that will help to raise the standard of living around the world. Open, competitive, international markets that encourage innovation, efficiency, and wealth creation are fundamental aspects of sustainable development (WBCSD, 2002). Economic prosperity is tied intrinsically to and interacts with the principles of social equity and environmental integrity (Schmidheiny, 1992; WCED, 1987).

Firms must apply the aforementioned principles to their products, policies, and practices in order to express sustainable development (Bansal, 2005). Below, the three principles underpinning sustainable development are discussed at the level of the firm. Corporations achieve environmental integrity through environmental management, social equity through corporate social responsibility and economic prosperity through value creation.
Corporate environmental management is an effort by firms to reduce the size of their environmental impact (Bansal, 2005). Every firm has an impact, whether it is merely by lighting office buildings or, more significantly, through the waste and emissions generated by production processes. A number of taxonomies have been developed to describe corporate environmental management, ranging from the more reactive to the more proactive (Aragon-Correa, 1998).

Corporate social responsibility requires that firms embrace the economic, legal, ethical, and discretionary expectations of all stakeholders, not only financial shareholders (Carroll, 1979). Wood's (1991) framework for socially responsible processes has achieved the greatest traction in business research (Hillman & Keim, 2001; Swanson, 1995; Waddock & Graves, 1997). Corporate social responsibility involves three processes: environmental assessment, stakeholder management, and social issues management (Wood, 1991). Environmental assessment or scanning enables firms to identify social, economic, and environmental issues and respond to them accordingly. Through stakeholder management, firms respond to individuals, outside organizations, and even the natural environment that have a legitimate stake in the organization. Social issues management is the process of addressing social issues, such as the decision not to employ child labor, not to produce socially undesirable products, and not to engage in relationships with unethical partners.

Companies create value through the goods and services that they produce (Bowman & Ambrosini, 2000). Connected to this is the concept of business model, which is often taken as the perspective to study value in the context of a firm. Value is created in this view by producing new and innovative products that are desired by consumers, by lowering the costs of inputs, or by realizing production efficiencies (Conner, 1991; Porter, 1985). When the firm sells the goods or services for a price that at least exceeds the cost of those goods and services, the firm captures the value it creates and enhances its financial performance (Bowman & Ambrosini, 2000). Nevertheless, high value creation is not always related to high financial performance. Market conditions or regulations through intense competition, for example, may erode the firm's ability to capture value (Makadok, 2001). When a firm does create and capture value, it distributes this value to consumers through its goods and services, to shareholders through dividends and equity, and to employees through salaries. For this to truly take root, a firm needs embed this to their innermost business logic and develop models to support this, as will be discussed in the section 2.3.

2.2 The Concept of Product-Service Systems

Product-Service Systems (PSS) have been identified as a very potential facilitator of sustainable business, which will be discussed further in the following section. The purpose of this section is to introduce and define PSS to facilitate the discussion that follows. This research, in accordance to Figure 2 from Baines et al. (2007), defines Product-Service System as an integrated product and service offering that delivers value in use. It consists of three parts: 1. Product: a tangible commodity manufactured to be sold 2. Service: an activity done for others with an economic value and often done on a commercial basis 3. System: a collection of elements including their relations.

In comparison to the traditional form of adding value, which is driven by the production process, competitive advantage in PSS derives from value provided through service use or function. Figure 2 illustrates well how the value of integrating products and services can increase with the new paradigm. The ultimate goal of such systems is to provide for the final need, demand or function to be fulfilled.

The development and delivery of products and services can be seen in different ways. The most traditional approach is the separated view; products and services are developed independently and organized in different departments. Further on, services can be seen as add-ons to the actual product; thus they are developed subsequently to a specific product (Figure 2). On the other hand Industrial Product-Service Systems represent a paradigm shift in the definition of service performance by considering tangible and intangible goods in an integrated way.

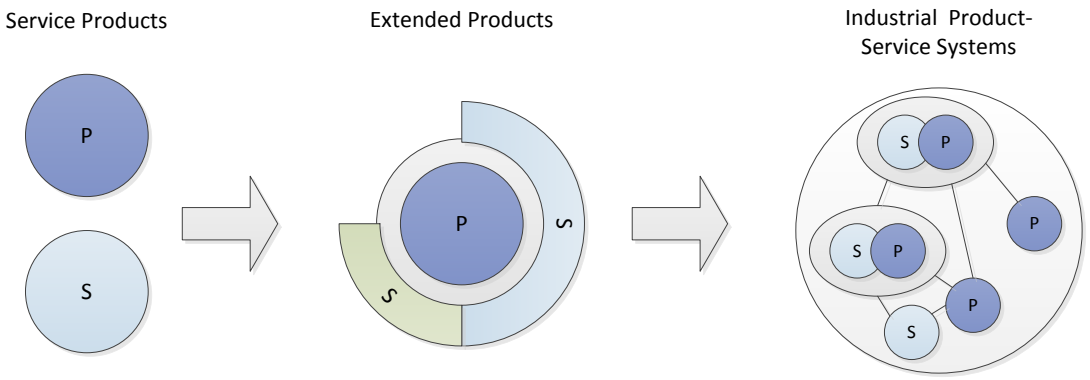

Figure 2: Types of Product-Service Systems. (Meier et al., 2010)

Within the PSS research domain, a lot of the discussion has revolved around potential improvements in sustainability, which includes the economic, environmental and social aspects (Tukker, 2004). It is argued that changing the product-service mix can facilitate

an increase in eco-efficiency, which helps to transform the present ‘transactional economy’ to a goal-orientated ‘functional economy’. The aligned nature of product and service offers better communication between the consumer and the supplier, which improves sustainability, where wastage of materials and energy is reduced. More on the possible ways that PSS facilitates sustainability will be discussed in the following section.

2.3 Business Models

2.3.1 Definition of a Business Model

Business model as a term is often associated sloppily in the public discourse with numerous managerial concepts. Unfortunately, neither is the research literature absolved of this sin. According to Weill et al. (2011), in spite of many years of research into the matter and the importance of the concept, no generally accepted definition has emerged. This may partly be so because of the interest in the concept from numerous different disciplines (Schafer et al., 2005). Still, even with all the misuse of the term and all the confusion connected to its definition, a good business model remains essential to every successful organization. A business model’s great strength lies in that it focuses attention on how all the elements of the system fit into a working whole (Magretta, 2002). A business model can help to capture, understand and communicate the structure for a company’s operations and the logic behind business decisions.

This work leans towards the view of value creation and capture logic, which is one of the most prominent streams in the business model research literature. For example, Casadesus-Masanell & Ricart (2010) define business model as “logic of the firm’ – how it operates and creates value for its stakeholders”. Schafer et al. (2005) share the idea of value creation and defines business models as following: a business model is the “representation of a firm’s underlying core logic and strategic choices for creating and capturing value within a value network.” Johnson et al. (2008) describe business models similarly – a business model “consists of four interlocking elements that, taken together, create and deliver value.” The view of value creation directly enables sustainability considerations as defined in the first chapter.

In contrast to many abstract definitions, a rather concrete definition by Osterwalder et al. (2005) will be applied in this research. They defined the business model as a conceptual tool which has a set of components and which determines the relationships of those elements when it comes to the business logic of a firm:

"A business model is a conceptual tool containing a set of objects, concepts and their relationships with the objective to express the business logic of a specific firm. Therefore we must consider which concepts and relationships allow a simplified description and representation of what value is provided to customers, how this is done and with which financial consequences."

The definition by Osterwalder et al. (2005) is sufficiently broad to embrace the different reflections on business models that sprung up in different fields such as e-business, strategy or management, but narrow enough to be meaningful and accurate (Pateli & Giaglis 2003).

2.3.2 The Components of a Business Model

Business model components represent the key aspects of the business that a company operates in (Westerlund, 2009). The business model can be seen as a conceptual link between strategy, organization and systems. Business model shows how the components of a business fit together, while strategy also includes competition and implementation. A clear understanding of the components is crucial, because many people speak about business models when they really only mean parts of a business model (Linder & Cantrell, 2000). For example, an online auction is not a business model, but a pricing mechanism and, as such, one part of a business model.

Similarly to the definition of the business model, different studies represent several classifications for the components; therefore, no unanimously accepted agreement on the elements has been formed (Morris et al., 2005). To clarify this confusion, Osterwalder et al. (2005) reviewed extensively 14 influential business model articles and synthesized the domains addressed in them. They additionally pointed out in their review that implementation and execution are largely neglected in the literature and took that perspective for their synthesis. The simple idea behind this perspective is that a good business model can be managed poorly leading to weak results.

Business model implementation and management include the 'translation' of the business model as a plan into more concrete elements, such as a business structure (e.g. departments, units, HR), business processes (e.g. workflows) and infrastructure (e.g. buildings, ICT) (Brews & Tucci, 2003). This must be reflected in the components that the business model is broken into. One of the goals of this research is to provide concrete ways to develop the decision making and implementation and the only way to do that is to look at business modes in more detail. Therefore, this work will take the component view and apply the Osterwalder et al. (2005) classification for the different components of a business model called the 'nine building blocks'. They are portrayed in the Figure 3.

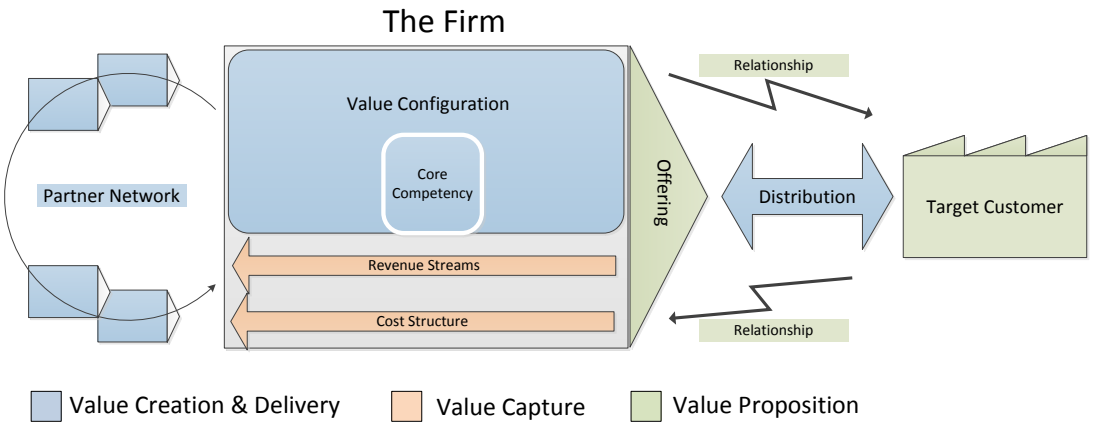

Figure 3: The components of a business model. (edited from Osterwalder et al., 2005 and Bocken et al., 2014)

Figure 3 portrays the nine components or 'building blocks' of a business model. Offering lays out the specifics of a company's bundle of products and services. It is a promise of value to be delivered and a belief from the customers that value will be experienced. Target Customer describes the segments of customers a company wants to offer value to. The segmented groups of course need to be similar in ways that are relevant to the business model. Relationship explains the kind of links a company establishes between itself and its different customers. It is the way the company communicates and deals with the customers. Distribution Channel describes the various means of the company to get in touch with its customers. It is the path through which products and services travel to the customers and information and revenue to the company. Value Configuration describes the arrangement of activities and resources to deliver value. Core Competency outlines the competencies necessary to execute the company's business model. Core competency has a clear link to strategy as it is a particular strength relative to competitors. Partner Network portrays the network of cooperative agreements with other companies necessary to efficiently offer and commercialize value. Cost Structure sums up the monetary consequences of the means employed by the business model. Revenue Model describes the way a company makes money through a variety of revenue streams. It is a system design by which the company monetizes its products and services (Osterwalder et al., 2005).

2.3.3 Product-Service System as a Business Model

Business models can be categorized based on the mix of tangible and intangible components (Baines et al. 2007). Without a doubt, there are innumerable ways to mix these components and to manage them. Despite this diversity, it is possible to categorize business models along two main dimensions, a model's core activity, which is naturally dependent on core competency, and its relative position in the price/value continuum (Linder & Cantrell, 2000). In terms of core activity, a business model can focus on

providing – generating income by selling goods and services. Tukker (2004) calls this a function oriented business model or a PSS. Another way to focus the core activity is to carve out a channel role – profiting through customer management that wraps around the offerings. These can include sales techniques, new buying experiences or advise about the product or service. One more category is intermediary models that bring sellers and buyers together on newly created markets.

A business models' relative position on the price/value continuum can range from high value, premium prized innovations to low prized, standardized offerings. In the middle range, models focus on value-in-use distinctions other than unique function or lower price. These include attractors like quality, reliability, convenience, ease-of-use, etc. Sometimes the difference between customer management techniques and attractors is not very clear. Additionally, it is good to note that it seems that the most innovative business models are created by combining features from two or more categories (Linder & Cantrell, 2000).

A PSS offering consists of tangible products and intangible services designed and combined so that they jointly are capable of fulfilling specific customer needs (Tischner et al., 2002). The value provided by the concept of PSS is a broad, holistic view on technical systems by taking into account technical artefacts, services, business models and drivers like sustainability and business advantages (Müller & Stark, 2010). The premise is to provide 'added value' or 'superior value' to satisfy customer needs along the whole lifecycle of a product-service system (Müller et al., 2010). As mentioned, the basic idea is not to sell products and services separately, but to sell a defined result, a system's availability, or just functionality. Customer needs are not reduced to the single need for product ownership. Instead, business models (Tukker, 2004; Meier et al., 2005) define the value for the customer and couple customers and providers for longer periods. Maintenance, adoption to changing needs and boundary conditions, reconfiguration or upgrading can be part of a PSS, for example in form of services included in the business model. The integration of products and services finally can maintain or enhance functionality of a product or a service or implement new functions, which are not available without integration. In industrial markets, PSS are sold instead of standalone products or services to exploit earlier unused economical and technical potentials or to enhance the value for the customer (Meier et al. 2005). The contractors share responsibilities and risks.

2.4 Sustainable Business Models

2.4.1 Sustainable Business Model Archtypes

A sustainable business model is one that contributes to sustainable development by delivering simultaneously economic, social, and environmental benefits — the so-called triple bottom line (Elkington, 1994). It is a vessel for bringing sustainable product and service innovations to market. Beyond this broad consensus, Boons & Lüdeke-Freund (2013) provide an extensive review on the business model literature and connect it to sustainable innovation. They find that the literature often neglected the way the firms need to combine the components of a business model to bring sustainable innovations to market. Sustainable business models must of course apply the discussed three principles of sustainability: environmental integrity, social equity and economic value creation, but there are additional normative requirements. Through its components, the business model concept highlights three aspects that are vital for sustainability (Boons et al., 2013):

- The value proposition makes it explicit that the relationship between the firm and its customers is not built around a specific product or service, but rather by the exchange of value. This allows that what is deemed valuable can be questioned and redefined. It is widely argued that PSS assists in this redefinition.
- The value configuration points directly to the larger system that the firm is a part of, economically, technically and socially. It makes it clear that the activities of the firm are embedded to a larger system.
- The distribution of costs and value point toward the requirement that all involved actors need to have a sound balance of costs and benefits.

Bocken et al. (2014) build on Boons & Lüdeke-Freund (2013) and synthesize conceptual and empirical findings extensively. Figure 4 portrays their extensive work on creating a typology of archetypes for sustainable business models. The literature and practice of innovations for sustainability is vast but fragmented, with various conceptual papers and many potential innovative approaches. Figure 4 unifies these disparate contributions that deliver sustainability from the literature and practice under a common theme. It provides mechanisms to assist the innovation process for embedding sustainability in business models. This is highly relevant for developing sustainable PSS and defines a clearer research agenda for this thesis.

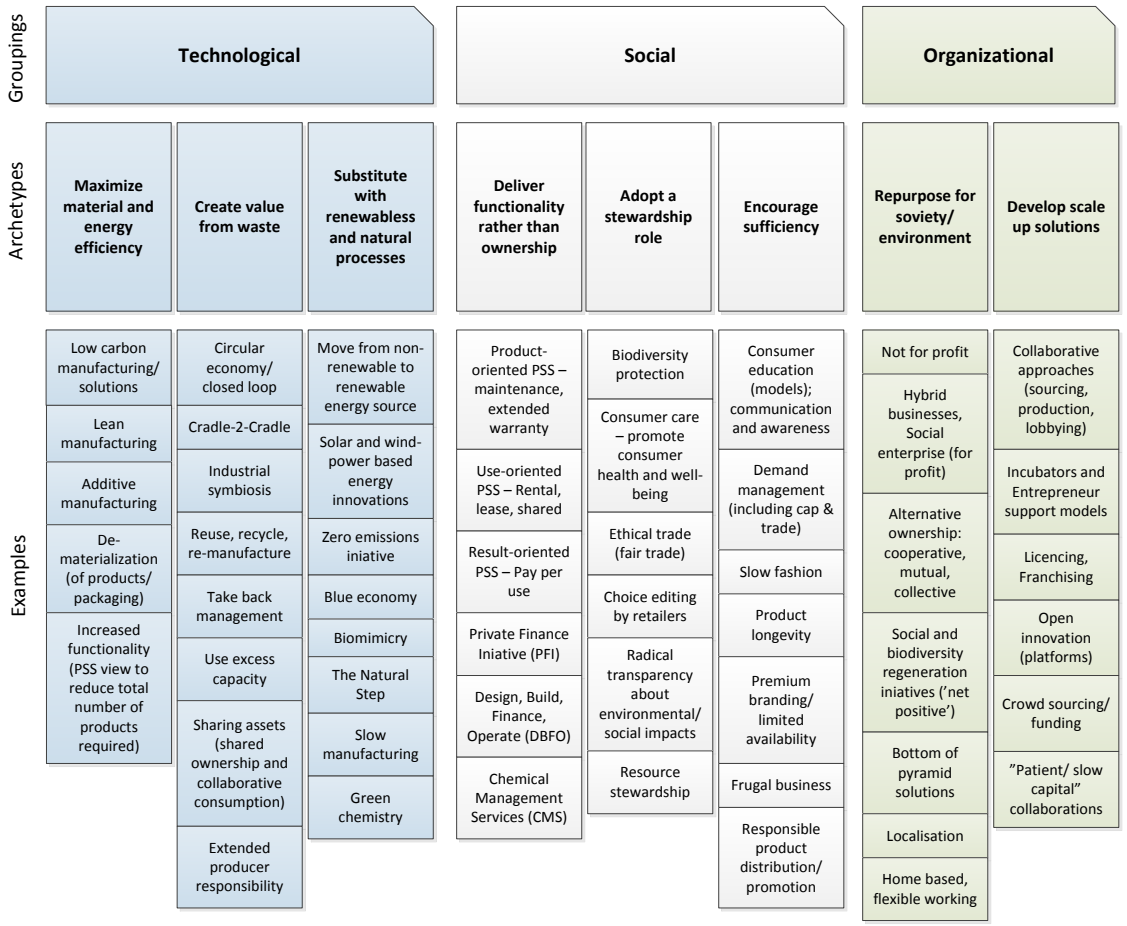

Figure 4: Sustainable business model archetypes (Bocken et al., 2014)

This research focuses on PSS development, which by default connects it to the technological grouping in the figure above. In addition, substituting ownership with functionality is relevant, when it comes to PSS. The social and societal innovations in business models are probably less relevant for this research. In general, PSS development is highlighted on the left half of Figure 4, where the focus is the value creation and delivery of the company.

2.4.2 Product-Service System as a Sustainable Business Model

As Gummesson (1995, p. 250) states: "customers do not buy goods or services: they buy offerings which render services which create value". The bundling of products and services does enable additional sustainability considerations. The key is to consider how the functional requirement can be met: through a product, a service or some combination of a PSS, and optimizing the sustainability impacts of these options with traditional criteria. The use of sustainability criteria may result in a product not being produced at all. This is in circumstances where it is more sustainable and feasible to meet the required functionality by the provision of a service. In practice, complete replacement of a

product by a service is next to impossible to achieve. Some combination of PSS is a more likely possibility (Maxwell & van der Vorst, 2003).

The key to sustainable PSS is that they are designed and marketed to provide customers with a particular result or function—clean clothes, mobility, warmth, etc.—without them necessarily having to own or buy physical products, such as a washing machine, a car or fuel, in order to get that result (Roy, 2000). In addition, the design of sustainable product-service systems may involve the development or use of 'eco-efficient' products that are more efficient in their use of energy and materials and generate less pollution and waste. Some scholars (Elsen, 1997; Manzini, 1995; Stahel, 1994) suggest that there are four main types of product-service systems that contribute to sustainability by reducing the total quantity of materials and energy required per unit of service rendered: result services, shared utilization services, product-life extensions and demand side management.

Result services (or demand services) aim to reduce the material intensity of existing systems by selling a 'result' instead of a product—public and shared transport is a simple example. The service provider typically takes responsibility for supplying, maintaining, taking back and recycling all physical aspects of the system. Shared utilization services (also called product use services) aim to increase the utilization of the material parts of a system by sharing the products required. For example, in clothes cleaning this would involve sharing facilities in a community wash center, instead of having washing machines in individual households.

Product-life extension services (sometimes called duration products) aim to substantially increase the useful life of products or materials through maintenance, repair, reuse and recycling, thus reducing the amount of energy and resources required to provide a given function. A simple example would be a company that supplied personal computers, maintained and upgraded them, and took them back for recycling at the end of their life. Demand side management (or least-cost planning) originated in the field of energy supply. Following the oil crises, electricity suppliers realized that it was often more economical to reduce energy demand than build more generating capacity. This concept evolved into the idea of considering the end-use service that electricity buyers wanted (illumination, cooling, thermal comfort, etc.) and working out the least-cost method of supplying it. 'Least-cost' could take into account environmental and other social costs, or merely reflect the financial cost to the end-user.

2.4.3 Conceptual Value Elements in Sustainable Business Models

The ability to create and capture sustained added value is often seen as the key measure of success of business. To be successful then, a sustainable business model must create and capture value that is aligned with principles of sustainability. A simple division by

Tukker (2004) divides value experienced by the customer to tangible and intangible value. Tangible value is a straightforward concept. A customer who contemplates buying a product or a service can make a rational calculation of the benefits and the costs of the product: money, time, reliability, etc. and in principle this consideration yields the maximum price the customer is willing to pay. Intangible value is a little less straightforward. It is value and benefits that go beyond the actual product or service and that are not accounted for in traditional financial measures, such as a sense of community, human interaction, image enhancement or indeed environmental benefits.

The creation of tangible and intangible value alone is not enough. To be successful, a company needs to employ a business model that enables it to capture the value as well. To do this, the business has to create a kind of a quasi-monopoly by covering the essential parts of the delivery or production system, i.e. the parts that cannot easily be copied or performed by other parties (e.g. unique relationships with clients, unique technologies or patents). (Christensen et al., 2001)

Formal agreements in the partner network of a firm create intangible value. The adoption of schemes such as the Coalition for Environmentally Responsible Economies (CERES) Principles, the Global Compact, or the Global Reporting Initiative can eventually differentiate corporations from competitors as well as produce some positive outcomes for the firm (Orsato, 2006). As such, they offer a way to both lower environmental impacts across the value chain and enhance legitimacy and reputation by involving stakeholders in the conduct of on-going operations. Corporate image, for instance, might be enhanced, influencing a positive public opinion about organizational practices. By constructively engaging the partner network, firms increase external confidence in their intentions and activities, helping to enhance corporate reputation and catalyze the spread of more sustainable practices within the business system at large (Hart & Milstein, 2003).

Nonetheless, as in almost every sphere of management, superior value gained from differentiation is rather ubiquitous and captured often in a relatively short window of opportunity (Orsato, 2006). As firms within an industry adopt more ambitious practices, the beyond compliance frontier moves further, and what once was a differentiator (such as a certified Environmental Management System) becomes a normal and non-competitive practice thereby removing the possibility to capture more value.

Environmental sustainability often receives most of the attention, but social sustainability also offers opportunities to create and capture value. According Prahalad & Hammond (2002), the growing gap between rich and poor and the unmet needs of those at the bottom of the economic pyramid present opportunities for firms to grow the customer base and pave future growth. The realization of a more inclusive form of doing business characterized by two-way dialogue and collaboration with stakeholders previously

overlooked or ignored by firms (e.g. radical environmentalists, shantytown dwellers, the rural poor in developing countries) can help to open up new pathways for growth in previously underserved markets (Hart & Sharma, 2002). Thus, the discovery of the needs of underserved markets facilitate competitive imagination by creating a shared roadmap for future business and provide guidance to employees in terms of organizational priorities, technology development, resource allocation and business model design (Hart & Milstein, 2003).

It is also crucial to carefully consider the value proposition and offering of the firm when seeking to create value from sustainability. Ecology-oriented products and services represent a narrowly defined market niche that try to create ecology-oriented intangible value. In generic terms, "a firm differentiates itself from its competitors when it provides something unique that is valuable to buyers beyond simply offering a low price" (Porter, 1985). Environmental or social differentiation is certainly not for all. Firms that intend to generate superior value from eco-branding and capture it need to observe three basic pre-requisites: consumers must be willing to pay for the costs of ecological differentiation; reliable information about product's environmental performance must be available to the consumer; and the differentiation should be difficult to be imitated by competitors (Reinhardt, 1999a). Much depends on the ecology-related marketing efforts that appeal to consumers' desires to associate their actions (purchases) with products that have positive social and environmental benefits (Hart & Milstein, 2003).

In industrial markets, willingness to pay is driven by considerations of total cost; considerations of brand identification and image tend to play smaller roles than in consumer marketing (Reinhardt, 1999b). Tangible value seems to be therefore highlighted in industrial markets. Nevertheless, this bottom-line customer focus in industrial markets can actually facilitate sustainable product differentiation. In particular, an industrial product can be differentiated if it enables customers to reduce the environmental impacts of their own operations, thereby incurring fewer environmental costs (Reinhardt, 1998). If the firm initiating the scheme can reduce the private environmental costs of its industrial customers, it may be able to capture some of that cost reduction. The same should apply for social responsibility.

The value configuration of a firm has important implications to its cost structure and to the amount of value a firm can capture. Porter and van der Linde (1995) asserted that companies should promote resource productivity or eco-efficiency in the form of materials savings, increases in process yields, and better utilization of by-products —because waste consists, fundamentally, of an inefficient use of resources. In their view, companies would only need to find hidden opportunities to profit from environmental investments and eventually transform such investments into sources of additional captured value.

Hart & Milstein (2003) add that the problems of material consumption, waste, and pollution associated with industrialization present an opportunity for firms to lower cost and reduce risk through the development of skills and capabilities in pollution prevention and eco-efficiency. Less waste means better utilization of inputs, resulting in lower costs for raw materials and waste disposal. By deriving more saleable product or service per unit of input, eco-efficiency can lead to lowered costs and reduced risk. According to Orsato (2006) empirical evidence suggests that eco-efficiency has greater potential to more captured value in firms that supply industrial markets, face relatively high levels of processing costs, and generate wastes and/or by-products. In this way, there is potential to being competitive both on price and environmental performance. It follows that eco-efficiency is probably the clearest and fastest way to create tangible value from a sustainable business model. The competencies that emerge from the search for cleaner production and technologies are central to a firm's efforts to reposition its internal skill set for the development and exploitation of future markets (Hart & Milstein, 2003).

2.4.4 Empirical Evidence for Sustainable Business Models

As discussed in the previous section conceptually, sustainability can add value elements to business models. Beyond compliance behavior might yield a better corporate image and prepare for ever tightening regulations. Furthermore, eco-branding is a way to accomplish differentiation and industrial ecology can facilitate this differentiation in addition to compliance. Also, there could be big under-served markets at the bottom of the pyramid. Still, probably the most important argument for sustainability is that eco-efficiency leads to cost savings and risk reduction.

The empirical findings presented in Table 1 support the argument that sustainable business models enable better value creation and capture and lead to better firm performance. However, the relationship between sustainability and firm performance is not linear or direct. The relationship was found to be mediated by key organizational capabilities, which in turn were dependent on sound decision making. It was clear that sound sustainable decision making was anchored on management, who possess sustainability knowledge and skills.

Table 1: Empirical findings on sustainable business models

Authors	Methodology	Purpose	Findings
Bohnsack et al., 2013	Case study	Explores how incumbent and entrepreneurial firms' path dependencies have affected the evolution of business models for sustainable technologies.(Includes only value proposition, value configuration and revenue/cost model)	Sheds light on the way in which technology and system attributes translate into specific components of a business model. Findings suggest that incumbents might not be involved in the first stages of the development of sustainable technologies. Entrepreneurial firms were the first to develop the main **novelties**.
Høgevold, 2011	Case study	Describes a corporate effort to implement a sustainable business model.	Sustainable business operations must be anchored and supported by the top-level management. The best results occur when analyzing the whole supply chain, focusing not only on the sustainability of the company's production facilities.
Surroca et al., 2010	Econometric analysis	Examines the effects of a firm's intangible resources in mediating the relationship between corporate sustainability and financial performance.	Results indicate that there is no direct relationship between corporate sustainability and financial performance, merely an indirect relationship that relies on the mediating effect of a firm's intangible resources (**innovation**, human resources, reputation, culture).
Eiadat et al., 2007	Survey	Examines the link between environmental innovation and business performance.	Managers who believe that environmental issues should be a top priority and possess environmental knowledge and skills, are key factors that trigger sound environmental decision making. Environmental **innovation** strategy was found to be associated with firms' positive business performance.
Christmann, 2000	Survey	Analyzes the effects of environmental management best practices on cost advantage.	Results indicate that capabilities for process **innovation** and implementation[1] are complementary assets that moderate the relationship between best practices and cost advantage, a significant factor in determining firm performance.
Karagozoglu & Lindell, 2000	Survey	Tests the win-win argument that progressive sustainable business models yield competitive advantage and therefore better financial performance.	The results validate the positive competitive and financial impact of progressive sustainable business models contingent upon the presence of favourable external and internal conditions (supportive government regulation and environmental **innovativeness**).
Sharma & Vredenburg, 1998	Case study & Survey	Tests the arguments linking environmental responsiveness to organizational capabilities and performance.	Strategies of proactive responsiveness to the uncertainties inherent at the interface between the business and ecological issues were associated with the emergence of unique organizational capabilities (stakeholder integration, higher-order learning and continous **innovation**). These capabilities, in turn, were seen to have implications for firm performance.

[1]continously updating existing or implementing new technologies and equipment

Innovation, as usually defined, is the application of better solutions that meet new requirements, unarticulated needs, or existing market needs (Frankelius, 2009). This is accomplished through developing more effective products, services, technologies, or processes that are readily available to markets and society. Innovation activities of a firm are directly linked to the business model it employs. Business model is a vessel for bringing products and services to market. Firms take their offerings to market through a venture shaped by a specific business model, whether explicitly considered or implicitly embodied in the act of innovation and decision making during development (Chesborough & Rosenbloom, 2002).

As seen in Table 1, Surroca et al. (2010), Christmann (2000), Karagozoglu & Lindell (2000) and Sharma & Vredenburg (1998) all find that financially successful sustainable business is very much contingent on company innovation activities. Sustainability is found to lead to better business performance only through successful innovation. It is interesting to point out that even when this important link is supported by so many scholars, there is very little empirical research done on the actual organization and sequencing of sustainable innovation activities and how that influences business performance.

Høgevold (2011) and Eiadat et al. (2007) point out that sustainable innovation is dependent on sound decision making, which in turn depends on managers who believe that environmental issues should be a top priority and possess environmental knowledge and skills. However, these scholars do not look deeper into the factors that influence decision making activities in sustainable product-service development, but focus only on the manager attributes. For this research it is highly relevant that there is next to no research on which factors influence decision making, how decision making should be organized in sustainable product-service development or how decision making is different depending on the development strategy of the firm.

2.5 Strategic Decision Making in Sustainable Product-Service System Development

2.5.1 Strategic Decision Making

Many studies point at the critical role of organizational information processes in traditional product-service development success and confirm the importance of effective decision making (Lievens & Moenaert, 2000; Moorman, 1995). However, the effects of sustainability considerations and PSS approach for development is largely unexplored. Therefore, this study can contribute by focusing on the strategic level and on the unexplored effect of sustainable product-service development.

Strategic decision making is an organization's essential ability to adapt its survival and renewal (Evans, 1991) for product and service development success (Debruyne et al., 2002). The capabilities associated with strategic decision making can be viewed as part of a 'surprise management' approach, which necessitates early detection and analysis of strategic options (Kandemir & Acur, 2012). A crucial part of it is flexibility, which plays an important role for firms in adapting to changes in markets, technology, and competition (Nadkarni & Narayanan, 2007). Hence, this study views critical factors in strategic decision making the flexibility of decision making and the firm's ability to seek and foresee new opportunities as well as to adopt strategic decisions for an unknown environmental contingency (Ansoff, 1975).

The way managers process information into decisions is considered a major moderator of effective decision making (Van Riel & Lievens, 2004). However, the intangibility of the end product and generally high levels of uncertainty and complexity in the process complicate decision making substantially. How well organizations succeed in reducing the uncertainty surrounding managers affects their decision making effectiveness directly (Galbraith, 1974). Better decision making in development therefore will affect development success considerably (Shapira, 1997). Information plays an important role in the reduction of managerial uncertainty in development processes (Lievens & Moenaert, 2000). Important differences exist in the nature and sources of uncertainty at different levels and as a consequence in the way the organization and its decision makers should address it. For example, between the preoperational screening and business analysis phases, new service proposals are evaluated for potential profitability against a background of strategic objectives on the one hand and the operational new product development or new service development phase on the other (Booz, Allen and Hamilton, 1982).

Strategic decision making in product and service development projects deals with what ideas to pursue, what concepts and projects to invest in, and when and how to launch the product or service (Krishnan & Ulrich, 2001). Particularly the project selection deals with the most fundamental strategic issues that a company faces as it involves setting goals and allocating money and resources for the development. The justification of these decisions requires sufficient and accurate knowledge on both the status of the product or service and the surrounding environment. The decision making is often supported by acquiring such knowledge through idea and concept evaluation (Martinsuo & Poskela, 2011). Decisions in the development must lead to concrete, precise, and executable actions. For this, uncertainty needs to be reduced to a great extent. Therefore, effective information acquisition, diffusion, and processing are found to play key roles in the development (Van Riel et al., 2004). The availability of up-to-date and appropriate information increases decision making effectiveness. The acquisition of information therefore is an important antecedent of development success (Lievens & Moenaert, 2000).

The efficiency and effectiveness of communication influence how well and how fast information is transferred and diffused throughout the organization. The quality of organizational communication thus affects the availability of information to the decision makers and hence decision quality.

A factor affecting the speed and efficiency with which externally acquired information reaches the decision-maker is the strategic orientation of the organization; in particular the role new product development plays in the organization and the importance assigned to an open exchange of information (Van Riel et al., 2004). A positive attitude toward innovation and information exchange will stimulate development related communication (Jaworski & Kohli, 1993) and internal knowledge sharing (Burns & Stalker, 2001) and so will improve the transfer of relevant information present in the organization to the decision makers.

The more effort is devoted to gathering information, the more the diffusion of the information will be stimulated (Van Riel et al., 2004). Once information has been acquired and diffused through the development organization and has been communicated to the decision maker, the manager has to make efficient use of it. Decision making effectiveness improves when decision makers have experience with the subject matter (Perkins & Rao, 1990). Experience, the availability of relevant knowledge, facilitates the selection of relevant cues from available information and therefore leads to better decisions, especially under time pressure (Van Riel & Lievens, 2004).

2.5.2 The Front-End of New Product and Service Development

When the starting point for New Product or Service Development (NPD or NSD) is a technology or technical capability, the customer interface in connection to the new offering is often poorly understood, which leads to high uncertainty. The concept of the Fuzzy Front-End (FFE) illustrates the implications well. It is the period between when an opportunity is first considered and when an idea is judged ready for development (Kim & Wilemon, 2002). The FFE, as opposed to the actual product development phase that follows, is inherently non-routine, dynamic, and uncertain. The idea-development and subsequent idea-selection stages typically involve ad hoc decisions and ill-defined process (Montoya-Weiss & O'Driscoll, 2000). In the early front-end, fuzziness (uncertainty) about the commercialization potential of an idea might prevent an opportunity from proceeding to the development phase. This uncertainty can come from technology, markets, required resources, company-fit or capabilities (Kim & Wilemon, 2002). This ambiguous period holds several challenges for company decision making. Firms usually seek to deal with this uncertainty with different evaluation methods (Martinsuo & Poskela, 2011).

When the starting point for new products and services is an expressed market need, the accurate identification of potential adopters' and users' preferences and attitudes is a central prerequisite. The company has to determine the needs of a target market and adapt itself to satisfying the needs better than its competitors (Saxe & Weitz, 1982). In connection, Homburg et al. (2009) argue that the key here is the accuracy of frontline employees' perceptions of customer needs. In order to create value and satisfy customers in the interaction with individual customers, employees in interaction have to generate knowledge regarding customer needs. If the employees at the customer interface have formed an accurate perception of an individual customers' hierarchy of needs, they have developed a high degree of customer need knowledge (Homburg et al., 2009). There are several sources of customer need knowledge. Some pertain to structured data that is gathered from transactions. Others come from interactions with customers. Garcia-Murillo & Annabi (2002) argue that personal interactions with customers, unlike transactional data, lead to richer content and help explain why customers do what they do. While transactional data is useful to identify problems and preferences, it is difficult to determine the reasons for customer decisions. With personal interactions frontline employees can ask customers directly and have an idea of the source of problems, preferences, and needs

The information that is gathered from the interaction between a customer and a salesperson needs to be of course documented so that it can be retrieved and analyzed. This data can prove to be very valuable to the firm. They are crucial in revealing new market opportunities and the market potential of new services and product features. All in all, the knowledge about customer needs is an absolute prerequisite for the development of products and services from market needs. How to connect that knowledge to the decision making in the development is an equally important consideration.

2.5.3 The Special Case of Product-Service System

The NPD and NSD literatures show that new product development and new service development have much in common but also that internal organizational factors seem to be more important in service than product context. These differences pertain mainly to the specific characteristics of services, namely their intangibility, co-production with customers, simultaneity, heterogeneity and perishability that affect the development process of services and make them to a certain degree unique (Fitzsimmons & Fitzsimmons, 2000). The formal R&D department and R&D expenditures, on the other hand, seem to be more important in a new product than service context (Nijssen et al., 2006).

Scholars have not really defined any paradigm, set of standard tools or methods for decision making in PSS development. A comprehensive and unique methodological approach might be challenging in this area, where the margin of uncertainty about contextual conditions may be very high (Morelli, 2006). The only comprehensive conceptual

attempt that this research came across is connected to the recently finalized FP7 funded Sustain Value research project (Sustain Value, 2014).

Additionally, the application of such tools can be different from case to case. The intrinsic complexity of some PSS requires any methods to be used with a high degree of flexibility (Morelli, 2006). On the other hand, Manzini & Vezzoli (2003) argue that PSS development has to be seen as a short-term strategic process which will result in new forms of organization and innovative forms of co-production of value. In other terms, the uniqueness of the innovation does not lie in the area of technology, but in the way these more or less existing technologies can be systemized. Here we have a dilemma, as PSS development requires flexible methods. On the short term systemization is important, but uncertainty and complexity require flexibility.

This has clear implications for decision making. The previous section concluded that sound strategic decision making is the ability to adapt to uncertainty and renew product and service development. The challenge is then to systemize this flexibility in decision making. It was also found that there is minimal research on decision making in PSS development. It follows that this research needs to look at the traditional decision making in new product development, where such research has been done. Therefore, this research will build on the traditional NPD decision making literature. Also to clarify, by technology this work refers to the know-how, techniques, patented or otherwise proprietary processes, materials, equipment, systems, etc. that a firm employs in its operations.

2.5.4 Decision Making Factors in New Product Development

Although many uncontrollable market conditions can affect a new product's success, firms can effectively improve the accuracy of their new product decisions. In order to facilitate the understanding of a large number of factors that might impact these decisions, this study uses the grouping from Ozer (2003). As shown in Figure 5, the task-related factors pertain to task complexity, task importance, information scarcity and task instructions. The decision maker-related factors cover the expertise and diversity of people involved in new product evaluation. The elicitation-related factors are about the way the opinions of the new product decision makers are elicited. Finally, the aggregation-related factors are about the way different opinions are aggregated in new product evaluation. The details of these factors are discussed in the following sections and are highlighted in Figure 5.

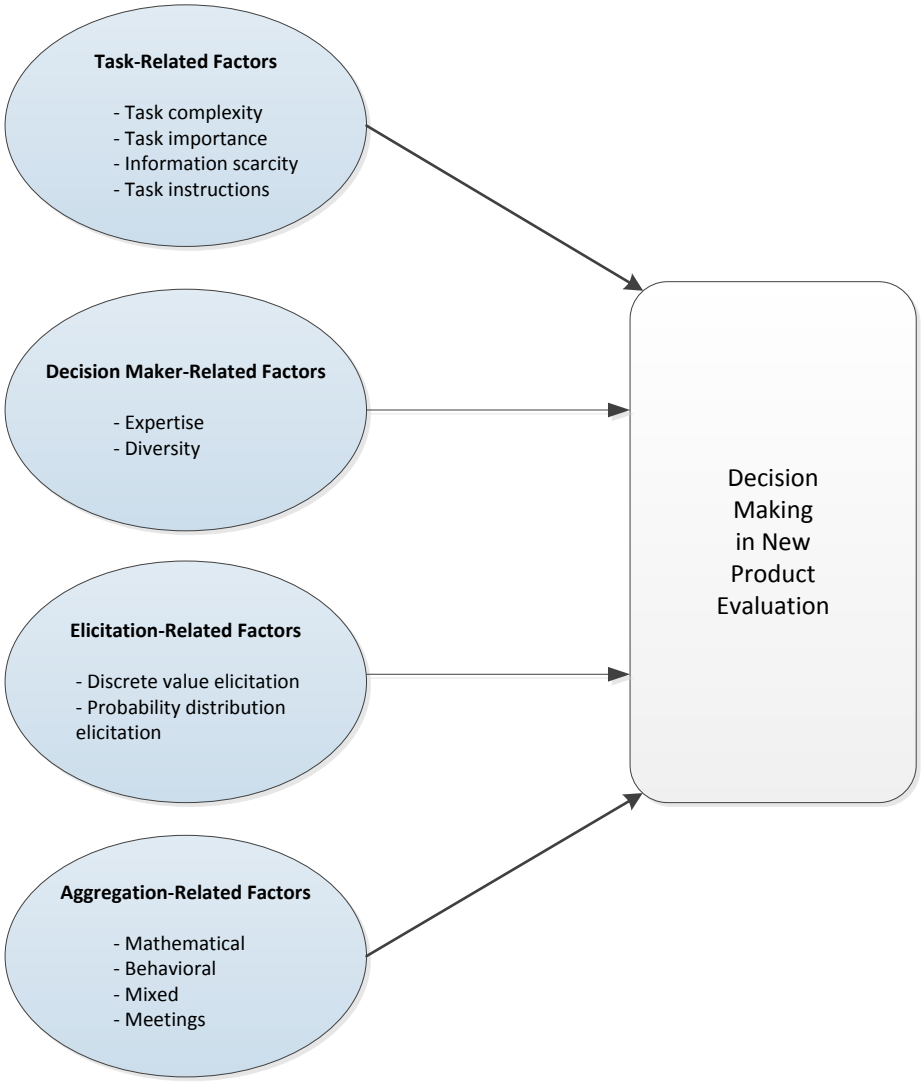

Figure 5: Factors which influence decision making in new product evaluation (Ozer, 2003)

Selecting the right ideas, concepts and solutions as product development progresses is among the major decisions that NPD managers must make. Companies have adopted evaluation criteria at progressive decision gates to offer the decision makers sufficient knowledge about the alternative ideas and concepts, and to promote choices that would result in the best possible business benefit (Martinsuo & Poskela, 2011). The task-related factors from Figure 5 deal with how task complexity and task importance shape the decision making. Companies seek to deal with complexity often with decision aids, which depend on the effectiveness of sub-task coordination (Ozer, 2003). Additional important factor is information, namely its scarcity and diffusion through instructions.

Previously, Table 1 highlighted that sound sustainable decision making was anchored on management, who possess sustainability knowledge and skills. The attributes of the decision makers surely are important. Figure 5 also hints that selecting knowledgeable and objective decision makers with diverse expertise will be positively associated with the accuracy of the evaluations in NPD. The third factor influencing the outcome of a

decision is the way the opinions of new product decision makers are elicited. There are two general ways of eliciting the opinions (Ozer, 2003). The first is to give discrete values, assuming that the opinions can be expressed as such values. The second general approach is to elicit a probability distribution. Although using familiar discrete values can be very useful in new product evaluation, past research has long contended that just reporting a discrete value might give the illusion of too much precision and objectivity. It appears that eliciting a probability range of more and less optimistic estimates increases the accuracy of evaluation at decision gates (Mullins & Sutherland, 1998).

Compared to asking a single person to evaluate new product ideas, asking a group of people usually improves accuracy, covers a wide range of views, increases the group's involvement in the decision making process and improves their commitment to implement it (Ozer, 2003). Thus, the last factor is how to aggregate the opinions of a group of people. There are several approaches to do this. Mathematical aggregation is of course more effective with clear and measurable criteria. Behavioral aggregation seems to be more effective for new products that require the decision makers to clarify the criteria and discuss merits. Mixed methods can be relevant when a wide range of viewpoints is desired.

2.5.5 New Product Development and Sustainability

Sustainability involves adding a further level of complexity into the development process. The process must continue to deliver core benefits to customers, while also addressing needs for improved sustainable performance and manage any necessary trade-offs with existing core or auxiliary product benefits. Addressing sustainability, and its emphasis on primarily non-financial outputs and consequences within NPD decisions, does imply some key differences between sustainable criteria and conventional development. The difference can also be seen as a redefinition of value.

First, sustainability brings a broader consideration of customer satisfaction. Environmental concerns are leading to new customer requirements beyond conventional functionality, quality and cost, relating to how products are made, how long they last and how they can be disposed of (Peattie, 1999). Second, sustainability focuses on physical product life cycles. Sustainability requires questions to be asked about the physical consequences of production and consumption. Addressing questions about where the raw materials going into products come from, and what happens to products post-use, reflect a physical 'cradle-to-grave' product life cycle perspective (Sharman et al., 1997). Third, sustainability brings a focus on design for end-of-life and post-use applications. A distinguishing feature of much sustainable activity is the attention given to the fate of products post-use, and particular design for the 'Five R's' of repair, reconditioning, reuse, recycling, and remanufacture (Wheeler, 1992). Fourth, sustainability augments the supply chain perspective. Suppliers have an important role in determining all aspects of

product quality, including sustainability, which requires a detailed understanding of the socio-environmental impacts of the whole supply chain, down to the simplest ingredient (Simon et al., 2000).

Additionally, technology plays an important role in sustainable development, because it is one of the significant ways in which we interact with our environment. Technology is paramount to many issues that are connected to sustainability. We use technologies to extract natural resources, to modify them for human purposes and to adapt our man-made living space. Additionally, it is through the use of technology that companies are able to tap underserved markets at the bottom of the pyramid and increase the quality of life of many people.

The ‘commercialization’ concept describes the process of developing a concept into a marketable product or service. It is a key part of NPD. Commercialization is the total process of moving a technology from the concept stage, to the production of a product and service and from there to market acceptance and use (Balachandra & Reddy, 2010). In short it means converting or moving technology into a profit-making position (Siegel et al., 1995). In becoming profitable, the first requirement is wide adoption by potential users in the chosen market. To describe that, this work takes the concept of market potential by Kalish (1985). According to him, market potential is the function of price and number of adopters.

Technology commercialization involves a process to develop a technology from concept to commercially viable product or service through various steps. The exact sequence and number of steps depends upon the industry and the sector where the company operates (Siegel et al., 1995). It is important to note that the market potential and every pattern of technology is socially conditioned. Technology commercialization is based on ideas, the conversion of ideas into inventions (working devices/processes), the commercialization of inventions into innovations (commercially viable devices/processes), and finally, the widespread adoption and dissemination by users (Balachandra & Reddy, 2010). The market potential and therefore the potential adopters and users are of course the key to success (Chen et al., 2011). They need to be identified, their perceptions need to be measured, the products and services need to be designed for their needs and they need to be informed about the product or service and its benefits.

Sustainable technologies face competition from often equally competent, cost effective, and mature existing technologies (Balachandra & Reddy, 2010). The need for sustainable technologies arises more often because of environmental and social concerns rather than business concerns. There is also resistance to change imposed by existing technological trajectories (Menanteau & Lefebvre, 2000). In addition, to meet environmental demands, R&D engineers sometimes sacrifice a little performance for new products (Chen et al., 2011).

As a result, misguided environmental considerations not only increase initial cost on product and service development, but erode original performance and value, and thus decrease price competitiveness and market potential. A wrong kind of approach to sustainability considerations may have a negative impact on commercialization success. In contrast, a clear understanding of sustainable value elements and the ability to exploit them offer value creation and capture opportunities. For example, while some sustainable technologies are costly, companies can save money through the lower costs of equipment and waste disposal. Sustainable value elements were discussed at length previously.

2.5.6 Empirical Evidence for Sustainable Decision Making in New Product Development

Table 2 presents important empirical findings on the antecedents and influencing factors that are associated with positive innovation results in (environmentally) sustainable NPD. Previously we concluded that sustainable innovation is dependent on sound decision making, but the table portrays confusing results on the impact of formal decision making systems. The importance of cooperation between NPD decision makers and environmental specialists is additionally highlighted.

Table 2: Empirical findings on environmental innovation

Authors	Methodology	Purpose	Findings
Chen et al., 2011	Survey	Examines the effects of technological attributes, market potential, and sustainability factors on the commercialization of technologies.	If the technologies possess the specific attributes of innovativeness, genericness, simplicity, and compatibility, as required by the potential adopters, the level of market potential will be more favorable and technology commercialization (TC) probability will be higher. In addition, the results indicate that sustainability requirements play moderating roles in affecting the relationships between market potential and TC probability.
Wagner, 2007	Survey	Analyses the hypothesis that EMS and managerial activities to reduce negative environmental impacts which are not part of EMS have a positive influence on the probability of environmental innovations.	Environmental management systems are associated with process innovations. The study does not find that environmental management systems are associated with product innovations. For product innovations, mainly information of consumers and eco-labelling activities show a positive association. Market research on the potential of environmental innovations positively relates to both process and product innovations.
Rehfeld et al., 2006	Case study & Survey	Examines the relationship between environmental organizational measures and sustainable product innovations.	The certification of environmental management systems has a significantly positive effect on environmental product innovations. Waste disposal or take-back systems of products seem to be an even more important driver for environmental product innovations. Analysis also shows that other factors that have been suggested in the literature such as environmental policy, technology push and market pull as well as specific other firm characteristics have a significant positive influence on environmental product innovations. According to analysis of environmental product innovators, not soft factors but economic aspects (i.e., higher prices) seem to be major obstacles to the commercial exploitation of environmental products and thus also to environmental product innovations.
Pujari, 2006	Survey	Reports on a survey of environmental new product development projects.	Factors that influence market performance of greener products are found to be cross-functional co-ordination between new product development professionals and environmental specialists, supplier involvement, market focus and life cycle analysis.
Pujari et al., 2003	Survey	Investigates the environmental responsiveness in industrial new product development.	Organizational antecedents on greening of industrial NPD include functional interface of environmental specialists with design and product managers, environmental product policy, and top management support.

Chen et al. (2011) find that sustainability requirements play moderating roles in affecting the relationships between market potential and technology commercialization probability. Meeting sustainability requirements is more helpful, when the technologies possess a high degree of market potential. For developing technologies in R&D projects, this implies that technologies with better market potential should seek to integrate sustainability factors into NPD decision making. The integration of sustainability factors may contribute to providing assistance with broadening market potential while meeting the requirements could generate additional design constraints and increase the costs for the commercializing firms. Accordingly, technological market potential can gain more complementary effects from sustainability considerations designed to improve its commercialization probability. Assessing the market potential is clearly an elicitation task mentioned in Figure 5.

Wagner (2007) and Rehlfeld et al. (2006) disagree on how EMS influences sustainable NPD. Wagner finds from German data that EMS is associated with process innovation and does not associate with product innovations. On the other hand, Rehlfeld et al. argue based on data from nine European countries that EMS has a significantly positive effect on product innovations. The broader scope might explain the difference, but it is interesting that Germany was one of the nine countries where the data originated. Still, whether it be process or product innovation, both are highly relevant for developing sustainable PSS offerings. The bottom-line is that EMS, which formalizes the sustainable decision making has a positive impact on sustainable innovation. It seems that EMS is a kind of a decision aid discussed in connection with the task-related factors of Figure 5.

Pujari (2006) and Pujari et al. (2003) both highlight the importance of a functional interface between NPD decision makers and environmental specialists. By this the researchers mean that environmental knowledge is shared, that the company assigns an environmental specialist a clear role in NPD and that the specialist influences the progression by issuing environmental guidelines that are reviewed at each stage or gate. If we consider Figure 5, aggregation related factors must be important in how NPD decision makers and environmental specialists interact.

2.6 Synthesis

Figure 6 synthesizes the discussion of previous sections to factors that influences decision making in sustainable PSS development. In sustainable PSS development tangible and intangible goods must be considered in an integrated way. As discussed, this adds considerable complexity to the decision making. Information about sustainable options and their business impact is often scarce and vague. Companies try to manage the mar-

ket, technology and process uncertainties inherent in the complexity through formalized EMS' and other decision aids.

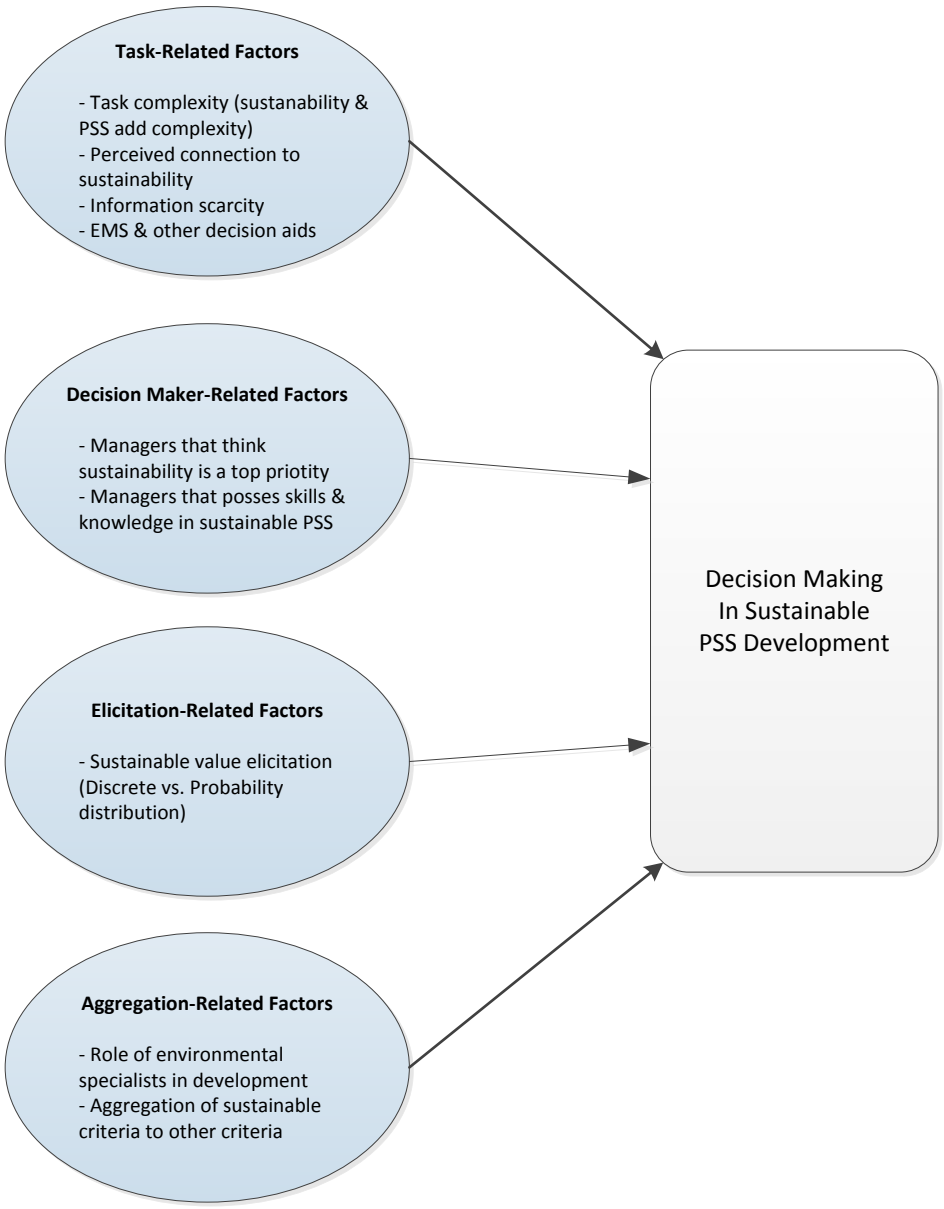

Figure 6: Factors which influence decision making in sustainable PSS development

Sustainable business operations must be anchored and supported by the top-level management. Managers who believe that environmental issues should be a top priority and possess environmental knowledge and skills are key factors that trigger sound environmental decision making. For sustainable business operations, the business model of the firm seems to be an important devise. It defines and conveys clearly how sustainable value elements are elicited.

Another important factor is how sustainability criteria are aggregated with other criteria like costs and quality in the development process and what is the role of environmental

specialists. By this, this thesis means the way the specialists set sustainable guidelines and how they are incorporated and reviewed at the different stages and gates.

It is good to note that the framework does not really enable taking the added complexity into consideration that comes with PSS and sustainability. A clear understanding of sustainable value elements and the ability to exploit them offer value creation and capture opportunities. Therefore the framework needs modification to take NSD and PSS better into consideration, if practical applications are proposed. What is meant by this, are the immaterial nature, low capital intensity and co-production with customers of services.

3. RESEARCH METHOD

3.1 Research Design and Material

The main research problem for this thesis is the need for companies to consider sustainability better in their PSS development and to understand business implications it has for the companies. For this end, the study will focus on three companies facing that situation. Yin (2009, p. 4) argues that case study as a research method is suitable for situations where a holistic view on a real life situation is desired. The method is suitable as a research method when acquiring knowledge of an individual, group or phenomenon. This research is conducted as a multiple case study in order to get a more general understanding of the phenomenon outside the uniqueness and individual conditions of a single firm (Yin 2009, p. 61). Another benefit of a multiple case study is that the results of the first case can be compared to the accompanying cases. As such, findings can be more easily generalized (Saunders et al. 2009).

In this study, the research methods used are observations and semi-structured interviews. The literature review has introduced the state-of-art and helped to structure the interviews. To form interview outlines and to improve the structure of the interview, the case companies were inquired for feedback on the topics in addition to interviewing key personnel tasked with decision making in PSS development. Observations also play a role in confirming the data from interviews to be accurate. Case study as a method gives a chance to get rich qualitative research data which helps answering the practical 'how' and 'why' research questions in the case context. Additionally, the case study method brings particular advantages in contexts where little previous empirical research is available on the subject (Eisenhardt, 1989, p. 536).

3.2 The Case Companies

Silverman (2010, p. 139) remarks that cases are seldom selected on a random basis. Saunders et al. (2009, p. 241) continues that sometimes there are difficulties to get permission of several companies to conduct the research in their companies, additionally Silverman (2010, p. 139) points out that case companies are very often selected because they allow access. These concerns do not directly complicate the research for this thesis. In this thesis, the case companies are selected by using convenience sampling (Saunders

et al. 2009, p. 241). What this means in practise is that the companies facing the phenomenon under study and participating in the context project are included.

In order to retain the anonymity for the case companies, no detailed information is provided concerning them. The companies are simply called Company A, Company B and Company C. All of the three case companies are based in Finland, operate in Northern Europe and are the leading companies of their respective industries. The companies are big with annual revenues of hundreds of millions of euros. The following sections briefly introduce the companies and give an overview of their business operations, organisation and strategy. The level of detail was considered to be sufficient for the purposes of this research as it is on explorative and aims to research a broader phenomenon.

The detailed company introductions have been omitted from the public version for confidentiality reasons.

3.3 Data Collection

Collecting data in the context of the joint project StraSus ensured the commitment of the case companies and provided a support network from other researchers, who were available to assist in the data collection. The empirical data was collected from the case companies in three ways, namely through informal discussions, semi-structured interviews and personal observations.

Developing the interview outline contained the following steps. Before contacting the case companies, both the theoretical understanding and the antecedents for the interview structure were formed based on a literature review and previous research concerning sustainable PSS development. The interview outline was also improved after feedback provided by the case companies, the supervisor of this thesis and the fellow researchers in StraSus. Then, after the first interview the outline was reviewed together with the other researchers in the project. The interview outline is provided in Appendix.

In total, nine individual interviews and five group interviews were conducted. Some 25 people took part in the group interviews. The interviewees were chosen together with a

company representative keeping in mind the interview outline and desired subjects. The interviewees were chosen based on their responsibilities to get informed answers and a broad view over the company activities. The interviews took from two to three days per company. Company contact persons were responsible for scheduling the interviews. The interviewees included key informants from sales, R&D, operations, environmental management and general management. Full list of the interviews including the titles and durations are reported in the appendix. Average interview duration was 92 minutes. Most of the interviews had at least two researchers present, where one would take the lead in interviewing and the other would take notes for clarifying questions and for later comparison of observations.

3.4 Data Analysis

The analysis of qualitative data is often considered to be a demanding process and there is no standardized procedure to go about it. However, there are multiple ways to uncover valuable findings out of a collection of non-numerical and non-standardized data. Saunders et al. (2009, p. 490) have grouped qualitative analysis into three main types of processes: summarizing data, categorizing data and structuring data using narratives.

To enable a rich material analysis, every interview for this study was audio recorded and subsequently transcribed. Following that, the data was categorised and coded (Saunders et al. 2009, p. 492) using a framework based on earlier literature on decision making in product and service development presented in the theoretical section of this report. Dedicated software called Atlas was used to code the transcripts. Corbin (2008, p. 66) emphasizes that coding is more than making a list of codes in a computer program. He continues that coding involves interacting with the data by utilising analysis techniques such as questioning the answers and comparing the data in order to derive concepts out of the data. An analysis of within-case data is made before a cross-case comparison. The interaction with data is presented and reported in the results section.

4. RESULTS

4.1 Single Case Analyses

The single case results have been omitted from the public version for confidentiality reasons

4.2 Cross-Case Analysis of the Role of Sustainability

The companies interpret sustainability in different ways, often in the context of their operations. All the case companies put the emphasis in sustainable development on the development as opposed to sustainability. The end result is often a compromise between environmental ambitions and practical business logic. The case companies were at different stages in implementing strategies, which all placed sustainability to the core of operations. Still, there was a tendency to emphasize efficiency and cost savings and the environmental measures needed to be justified through them. Table 3 presents the comparison.

Table 3: Comparison of the role of sustainability

	Company A	Company B	Company C
Definition of sustainable development	In addition to responding to environmental and social issues, quick reaction and continuous improvement on the long-term.	A holistic view of energy production in the long-term over generations. Emphasis on emission standards and systems.	Practical business logic dominates the definition: compliance, continuous process development and profit responsibility.
Role of sustainability in strategy	The whole strategy is based on material efficiency, energy efficiency, water efficiency and reducing emissions.	Clear milestones towards fuel efficiency, lower emissions and finally CO2-neutral energy production.	Strategy places the environment to the core of operations. The goal is to influence the whole value chain.
Role of sustainability in customer interaction	Sustainability mostly not used as a sales argument, but instead cost savings from efficiency and knowledge on how to reach compliance efficiently.	Sales arguments include mostly cost reduction and reliability, but occasionally compliance is important and customers rely on the company's good reputation on solving environmental issues.	Sustainability is not a sales argument per se, but the company is very active in communicating with the stake holders on the environmental performance of the company.
Role of sustainability in NPD/NSD	Environmental regulation and raw material prices drive the NPD/NSD.	New products and services are geared towards operational efficiency. Sustainability is seen as a byproduct of efficiency.	The NPD/NSD is looking for new direction. Organization and processes are underdeveloped. Current focus on commercializing existing sustainable technology.

All case companies communicated a strong commitment to sustainability, but the results on how this was reflected to practise were rather contradictory. For example, the companies had ambitious goals for the operations, but sustainability was not used as a sales argument. Instead in customer interaction the focus was on environmental regulation and how well the companies comply and can help customers to comply. It seems that all the companies had strong intentions and goals connected to sustainability, but the implementation was still incomplete. It could be said that Company A is furthest in their implementation, which also is reflected positively in the operations and results as can be seen in the analysis of the following sections.

4.3 Cross-Case Analysis of New Product and Service Development

In NSD and NPD, the companies rely on very different approaches. Company A is very much focused on customer needs and aims all development activities on projected new customer needs. Additionally, Company A puts a lot of resources in rapid testing at an early stage. Company B is more traditional in the development. A notable exception and novelty is the idea sharing tool, which brings new dimensions to the rather linear progression of development. Company C is at the opposite end when compared to Company A. Their development is slow and careful, every resource scarcely distributed.

Granted, the financial struggles of Company C are probably reflected here. Table 4 presents the comparison.

Table 4: Comparison of the New Service and Product Development

	Company A	Company B	Company C
Evaluation	Market potential, risks and key financial indicators	Customer value, novelty, financial gain and fit with the portfolio	Risks, market potential, effect on stakeholders, effect on nature. Project specific.
Technology push		The company has been quite successful at commercializing technology and knowledge it developed originally for own use.	Current focus on commercializing technology that was developed for own use. Venture at initial stages.
Probe-and-learn	A lot of resources go to testing different solutions at a rapid pace. A new idea ends up very easily to be tested at pilot-stage with considerable resources.	The development is dominated by a traditional project model and linear progression. A notable exception to this is the participation enabled by the idea sharing tool.	
Role of customer needs	Long-term R&D focuses on developing technology that caters to customer needs that are expected to actualize with new regulation and raw material price increase. On the short-term R&D is focused on specific customer solutions.	The company is in transition from pushing technology to truly quantifying customer value and focusing on customer needs.	R&D currently minimal, unstructured and seeking direction. Customer needs are irregularly present in NPD/NSD. Some interaction with clients in pilot projects.
Composition of PSS	The offering palette and the development of new offerings is dominated by services and a service point of view.	Products are targeted to specialized niche markets with little competition. Otherwise, services dominate the offering palette.	First baby steps towards PSS. Current portfolio commodity like basic products. New venture more service focused and integrated with products.

One notable difference between company A and the two others was the emphasis on quick reactions. By this, the point was the capability to react quickly to changes in the business environment and in development projects. Additionally, the company processes were highly developed and sophisticated as was previously presented. The inflexibility that characterized Company B and C was non-existent. Furthermore, the Companies A and B invested considerable resources to R&D, which was not the case with company C. It could be very enlightening to investigate more closely if these results are directly reflected in the growth and profitability of the companies.

4.4 Cross-Case Analysis of Decision Making

The different approaches to NPD/NSD are also apparent in the decision making of the companies. The decision making of Company A is flexible and rapid and able to re-

spond to considerable ambiguity through rapid progression and testing of alternative options. Company B utilizes extensive support systems and requires a lot of data. This appears to be a direct consequence of the linear progression. Decision making at Company C on the other hand is slow and very careful, which is also due to the scarce available resources and the desire to protect them. Also in the background is the experience with several, considerable, failed investments.

Table 5: Comparison of decision making

	Company A	Company B	Company C
Task-Related Factors	The development is characterized by high flexibility and rapid testing of ideas. This adds to initial ambiguity, but pays off in faster validation of results, which decreases complexity.	Extensive decision support systems facilitate the development. The company needs a lot of data to proceed with decision making. This is due to information complexity.	The organization and processes are underdeveloped and are seeking direction. Risk assessment takes a lot of time and is very careful.
Decision Maker-Related Factors	The managers possess skills and knowledge in sustainability, which is evident in the success of the company in solving environmental issues. Managers outside sales think that sustainability is a top priority. Sales managers felt that this is not visible in customer interaction.	The focus is not on sustainability skills and knowledge. The managers focus on O&M abilities and interpret that this supports sustainability efforts also.	Environmental managers in a separate silo. Sustainability knowledge and skills not present in the rest of the employee population. The company employs extensive reporting and training to change this.
Elicitation-Related Factors	Discrete cost savings logic dominates the sustainable value elicitation	Discrete process efficiency logic dominates the sustainable value elicitation	Nature seen as an eigenvalue. Extensive environmental investments done without direct cost savings logic.
Aggregation-Related Factors	The company sets very ambitious targets well above regulation levels which are aggregated above other criteria. The contradiction between sales and other parts of the organisation on the value of sustainability indicates how important organisational alignment is in aggregation.	Sustainable criteria are not above other criteria. When compliance is reached, sustainability targets decrease in importance. Idea sharing tool plays an important role in aggregation.	Sustainable criteria and goals are extensive, come first and cover the whole value chain. Aggregation is pursued in the value chain by strict control, reporting and rewards. Still, it is rather detached. Environmental managers play key roles in operations.

The decision making comparison is expanded on in the following section, where also the results are synthesized and connected to the previous theoretical discussion. Furthermore, the synthesis includes the role of sustainability and the state of NPD/NSD, which were discussed in the results and in this cross-case analysis.

4.5 Updated Framework of Sustainability-Based Decision Making

Sustainability in the context of a firm contributes by delivering economic, social, and environmental benefits simultaneously in their offerings. Firms must apply the aforementioned principles to their processes, policies, and practices to express sustainable development in their decision making. Still, the companies interpret sustainability in different ways, often in the context of their operations. All the case companies put the emphasis in sustainable development on the development as opposed to sustainability. The end result is often a compromise between environmental ambitions and practical business logic.

The results reveal a probe and learn process into information processing regarding service development. Many interviewees concluded that success was often dependent on how deep the clients invited their suppliers into their own processes. One case company recently discontinued the centralized development of solutions and divided it into the business areas, so that service development can interact better with clients and experiment with new concepts in a simpler way. Another case company has built a broad research portfolio that is based on experimenting with different things at a fast pace and communicating customer needs horizontally inside the company.

Figure 8 presents the factors that influence decision making based on the results. There are many similarities with Figure 6 that synthesized the theoretical discussion. The foremost additions to the theoretical discussion include the cost savings and efficiency orientation of value elicitation and how the business environment and company organization influence the decision making. The groupings follow that of Ozer (2003), which was presented in the theoretical discussion and are based on the presented results and cross-case analysis.

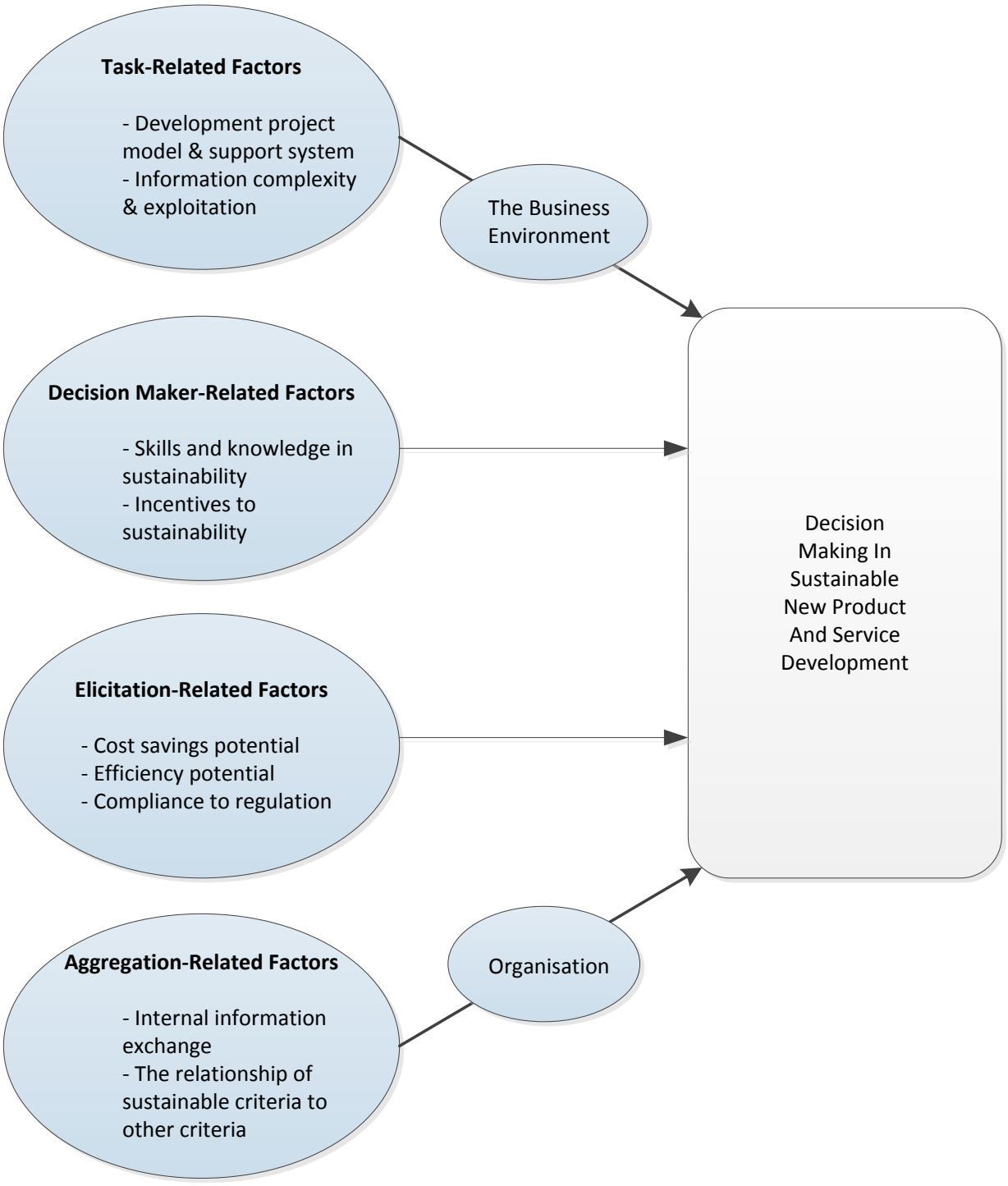

Figure 8. Factors that influence sustainable decision making based on the results

The results confirm how all of the four factors, including task-related, decision maker-related, elicitation-related and aggregation-related factors, influence decision making. The results point to the existence of additional factors, namely: internal information processes, incentives, cost saving orientation and the relationship of sustainable criteria to other criteria. Additionally, the business environment and organisation were found to mediate heavily the task-related and aggregation-related factors. It is good to note that

this research does not assume to have discovered all relevant factors. The list of factors certainly is considerably longer and a more extensive study would reveal additional ones. An important additional observation was that sustainability and NPD/NSD cannot be considered or studied as separate subjects. In order to achieve, they must be considered together as an integrated whole. Only when looking at all sides holistically can the company truly create products and services that are both sustainable and financially attractive to produce.

The suitability of the framework by Ozer (2003) was reasonably good. The task-related factors pertain to task complexity, task importance, information scarcity and task instructions. In cross-case analysis it was discussed how the project model and existing processes were in a key role in managing task-related factors. Additionally, the business environment influenced the task-related factors in a fundamental and mediating way. The decision maker-related factors cover the expertise and diversity of people involved in new product evaluation. This was directly applicable to sustainability, but the results hint to additional factors like personal incentives. The elicitation-related factors are about the way the opinions of the new product decision makers are elicited. For all case companies the foremost elicitation was the perceived cost-savings and efficiency potential. Finally, the aggregation-related factors are about the way different opinions are aggregated in new product evaluation. This was found to be very much dependent on the way that NPD/NSD was organized in the companies and how well the internal information exchange was working. This was also connected to what was the relationship of sustainable criteria to other criteria in NPD/NSD evaluation.

There were some challenges in using the framework as it was developed based standard NPD research. For example, the framework does not enable taking the added complexity into consideration that comes with PSS and sustainability. A clear understanding of sustainable value elements and the ability to exploit them offer value creation and capture opportunities. Therefore the framework needs modification to take NSD and PSS better into consideration, if practical applications are proposed. What is meant by this, are the immaterial nature, low capital intensity and co-production with customers of services.

5. CONCLUSIONS

5.1 Academic contribution

The purpose of this thesis was to explore how companies could develop their sustainability-based strategic decision making as part of product and service development activities. The objective was increased understanding on the ways in which companies embed sustainability into their decision making and information search. The research was explorative in nature and provided additional insights to how companies can embed sustainability to their decision making.

It was found that companies can develop their sustainability-based strategic decision making and enable the creation of sustainable business by developing a consistent strategy that places sustainability to the core of operations. Consistent implementation was found to be just as important. In all cases the strategy and implementation took the form of anticipating tightening regulation, then developing capabilities to efficiently comply before other companies and then selling and marketing those offerings to prospective customers. The study made use of the framework developed by Ozer (2003) and found several factors that need to be considered when seeking to the take sustainability better into consideration in the implementation. These factors were task-, decision maker-, elicitation- and aggregation-related.

Additionally, in the theoretical discussion, a wide array of conceptual value elements of sustainability was discussed. It became very clear from the results that the only value elements relevant to practice for the companies were those that brought demonstrable image benefits, cost-savings and efficiency gains. The companies did not consider value elements outside practical business logic. Still, the company cases show that sustainable value elements are featured into strategic decision making sometimes through purposeful problem solving, responses to direct customer requests and reactiveness to public attention. This represents a clear contrast to benefit-centered strategic decision making that is embedded into project selection criteria and agreed procedures of the product and service development process. The results contribute by revealing some requirements for strategic sustainability, and the information processing routines and mechanisms companies use in embedding sustainability into their strategic decision making.

The theoretical discussion implied that sustainable business models are dominated by PSS and services. The results confirmed this. All the case companies were moving from production to offering more and more services. It seems that at least the sustainability orientation of strategy and government regulations were the factors influencing and driving this development. The results of this research did not find any support for the organizational grouping of business model archetypes in Figure 4. On the contrary, all the case companies were gravitating towards practical business logic based on technological solutions, which are highlighted on the left half of Figure 4. This might highlight the orientation of the chosen case companies, but still, when considering the experience that this thesis gives, it is hard to see real, profitable business opportunities in organizational business models or find companies that would be willing to experiment with them. Also, this finding is additional support to the previous empirical results that profitable business based on sustainability is very much mediated by the sustainable innovation of the company.

5.2 Managerial implication

It would be very beneficial for managers that wish to take sustainability better into consideration in R&D to be foremost aware of the task-, decision maker- and aggregation-related factors. The task-related factors pertain to the complexity, communicated importance, information scarcity and instructions for reaching sustainability. The decision maker-related factors cover the sustainability expertise, incentives and diversity of sustainability experience of the people involved. The aggregation-related factors are about the way different opinions are aggregated in new product and new service evaluation. Often the bottom line is what kind of a role the environmental managers have in the development activities and what kind of importance is placed on their opinions.

It is hard to embed sustainability without thorough support from the whole organization. Of course the strategy needs to set specific and quantifiable goals for sustainability, but the task of implementing those goals without support systems is challenging, because of the ambiguous nature of sustainability. The project model and processes in the development need to be flexible and enable very different kinds of projects, with differing time scale, sequencing and progression. The human resources involved in the development need to have the right experience in sustainability and the right incentives. The role of those with most skills in sustainability often defines the whole effort. If they are not respected enough or listened to, practical business logic can easily overwhelm those considerations. This matter points also to the need to clearly define the relationship between traditional evaluation criteria and sustainability criteria. If the goal is for example a certain emission level, then it is good to define what the acceptable impacts on sales or profit are.

5.3 Limitations and future research

Without question, interviews from three case companies provide only limited empirical data. Therefore, the conclusions drawn from them are also limited. Still, the nature of this research was explorative and several insights were obtained. An additional limitation with the chosen cases is that data from the companies that have a very different position in their value chains makes it challenging to deduct the cause and effect of that position. The results do imply in some cases a different decision-making logic for sustainability questions from the traditional, predictive and calculative decision-making approach. Sometimes the divide between the traditional logic and sustainability was not clear even to the case company employees themselves. Further research of this divide would be beneficial and interesting.

When a business model serves to build linkages among partners that are necessary to successfully market a sustainable product or service, various elements being open to multiple interpretations can be challenging for the organizational alignment, but might also be an asset. In other words, the often lamented "vagueness" of the concept of sustainability may sometimes be a useful quality in bringing about sustainable innovations (e.g. Boons & Lüdeke-Freund, 2013). When companies have somewhat unique definitions, their approaches and solutions probably also differ. This is in contrast with some attempts in the literature to define, once and for all and objectively, the sustainability of an innovation. This suggests that the way in which sustainability is constructed by partners involved in value creation is an important topic for research, which was not covered in this thesis: How does the definition of sustainability, as constructed by stakeholders, compare to sustainability measures as employed by those who evaluate the sustainability of new products and services?

REFERENCES

Ansoff, H. 1975. Managing strategic surprise by response to weak signals. California Management Review 18(2): 21-33.

Anttonen, M., Halme, M., Houtbeckers, E. & Nurkka, J. 2013. The other side of sustainable innovation: is there a demand for innovative services? Journal of Cleaner Production 45: 89-103.

Aragon-Correa, J. 1998. Strategic proactivity and firm approach to the natural environment. Academy of Management Journal 41(5): 556-567.

Baines, T., Lightfoot, H., Evans, S., Neely, A., Greenough, R., Peppard, J., Roy, R., Shehab, E., Braganza, A., Tiwari, A., Alcock, J., Angus, J., Bastl, M., Cousens, A., Irving, P., Johnson, M., Kingston, J., Lockett, H., Martinez, V., Michele, P., Tranfield, D., Walton, I. & Wilson, H. 2007. State-of-the-art in product-service systems. Proceedings of the Institution of Mechanical Engineers, Part B: Journal of Engineering Manufacture, 221(10): 1543-1552.

Balachandra, P. & Reddy, B. 2010. Commercialization of sustainable energy technologies. Renewable Energy 35(8): 1842-1851.

Bansal, P. 2005. Evolving Sustainability: A Longitudinal Study of Corporate Sustainable Development. Strategic Management Journal 26(3): 197-218.

BCG & INSEAD. 2012. Handle with Care: Resource Management as a Competitive Edge. Available at: [https://www.bcgperspectives.com/content/articles/sustainability_process_industries_handle_with_care/]. Accessed 12.3.2014.

Bocken, N., Short, S., Rana, P. & Evans, S. 2014. A literature and practice review to develop sustainable business model archetypes. Journal of Cleaner Production 65: 42-56.

Bohnsack, R., Pinkse, J. & Kolk, A. 2013. Business models for sustainable technologies: Exploring business model evolution in the case of electric vehicles. Research Policy 43: 284-300.

Bowman, C. & Ambrosini, V. 2000. Value creation versus value capture: towards a coherent definition of value in strategy. British Journal of Management 11(1): 1-15.

Boons, F., & Lüdeke-Freund, F. 2013. Business models for sustainable innovation: state-of-the-art and steps towards a research agenda. Journal of Cleaner Production 45: 9-19.

Boons, F., Montalvo, C., Quist, J. & Wagner, M. 2013. Sustainable innovation, business models and economic performance: an overview. Journal of Cleaner Production 45: 1-8.

Booz, Allen and Hamilton. 1982. New Product Management for the 1980s. New York: Booz, Allen & Hamilton.

Brews, P. & Tucci, C. 2003. Building Internet Generation Companies: Lessons from the Front Lines of the Old Economy. Academy of Management Executive 17(4): 8-23.

Burns, T. & Stalker, G. 2001. The Management of Innovation, New York: Oxford University Press.

Carroll, A. 1979. A three-dimensional conceptual model of corporate performance. Academy of Management Review 4(4): 497-505.

Casadesus-Masanell, R. & Ricart, J. 2010. From strategy to business models and onto tactics. Long range planning, 43(2): 195-215.

Chen, C., Chang, C. & Hung, S. 2011. Influences of Technological Attributes and Environmental Factors on Technology Commercialization. Journal of Business Ethics 104: 525-535.

Chesbrough, H. & Rosenbloom, R. 2002. The role of business model in capturing value from innovation: evidence from Xerox Corporation's spin-off companies. Industrial and Corporate Change 11(3): 529-555.

Christensen, F., Raynor, M. & Verlinden, M. 2001. Skate where the money will be. Harvard Business Review November: 72.

Christmann, P. 2000. Effects of "best practices" of environmental management on cost advantage: the role of complementary assets. Academy of Management Journal 43(4): 663-680.

Conner, K. 1991. A historical comparison of resource-based theory and five schools of thought within industrial organization economics: do we have a new theory of the firm? Journal of Management 17(1): 121-154.

Corbin, J. 2008. Basics of Qualitative Research: Techniques and Procedures for Developing Grounded Theory. 3rd ed., Los Angeles: Sage Publications.

Debruyne, M., Rudy, M., Griffin, A., Hart, S., Hultink, E. & Robben, H. 2002. The impact of new product launch: Strategies on competitive reaction in industrial markets. Journal of Product Innovation Management 19 (2): 159-70.

Eiadat, Y., Kelly, A., Roche, F. & Eyadat, H. 2007. Green and competitive? An empirical test of the mediating role of environmental strategy. Journal of World Business 43: 131-145.

Elkington, J. 1994. Towards the sustainable corporation: Win-win-win business strategies for sustainable development. California Management Review 36(3): 90-100.

Elkington, J. 1998. Cannibals with Forks: The Triple Bottom Line of 21st Century Business. New Society: Stony Creek, USA.

Elsen, A. 1997. Sustainable service design. United Nations Environment Programme Working Group on Sustainable Product Development, Amsterdam, July 1997.

European Commission. 2009. Eco-Design of Energy-Related Products. Available at: [http://ec.europa.eu/energy/efficiency/ecodesign/eco_design_en.htm]. Accessed 14.3.2014.

Evans, J. 1991. Strategic flexibility for high technology maneuvers: A conceptual framework. Journal of Management Studies 28 (1): 69-89.

Fitzsimmons, J., & Fitzsimmons, M. 2000. New service development: creating memorable experiences. Thousand Oaks: Sage.

Frankelius, P. 2009. Questioning two myths in innovation literature, Journal of High Technology Management Research 20(1): 40-51.

Galbraith, J. 1974. Organization Design: An Information Processing View. In "Organizational Psychology", 2d ed. Kolb, D. (Ed.) Englewood Cliffs, NJ: Prentice Hall.

Garcia-Murillo, M. & Annabi, H. 2002. Customer Knowledge Management. The Journal of the Operational Research Society 53(8): 875-884.

Gummesson, E. 1995. Relationship Marketing: Its Role in the Service Economy. In "Understanding Service Management", pp. 134-156. Glynn, W. & Barnes, J. (Eds.) Dublin, Ireland: Oak Tree Press.

Eisenhardt, K. 1989. Building theories from case study research. Academy of Management Review 14(4): 532-550.

Hart, S. & Milstein, M. 2003. Creating Sustainable Value. Academy of Management Executive 17(2): 56-67.

Hart, S. & Sharma, S. 2002. Radical transactiveness and competitive imagination. Paper presented at the Academy of Management Annual Meeting, Denver, CO, USA, August 2002.

Hillman, A. & Keim, G. 2001. Shareholder value, stakeholder management and social issues: what's the bottom line? Strategic Management Journal 22(2): 125-139.

Holliday, C., Schmidheiny, S. & Watts, S. 2002. Walking the Talk: The Business Case for Sustainable Development. World Business Council for Sustainable Development: Geneva, Switzerland.

Homburg, C., Wieseke, J. & Bornemann, T. 2009. Implementing the Marketing Concept at the Employee-Customer Interface: The Role of Customer Need Knowledge. Journal of Marketing 73(4): 64-81.

Høgevold, N. 2011. A corporate effort towards a sustainable business model. European Business Review 23(4): 392-400.

IISD. 1995. GATT, the WTO and Sustainable Development. International Institute for Sustainable Development: Winnipeg, Canada.

Iles, A. & Martin, A. 2013. Expanding bioplastics production: sustainable business innovation in the chemical industry. Journal of Cleaner Production 45: 38-49

IUCN, UNEP & WWF. 1996. Caring for the earth: a strategy for sustainable living. Principles of Environmental Conservation and Sustainable Development: Summary and Survey. Rockefeller SC (ed.). Earth Charter Project, Earth Council: San Jose, Costa Rica; 129-131.

Jaworski, B. & Kohli, A. 1993. Market Orientation: Antecedents and Consequences. Journal of Marketing 57: 53-70.

Johnson, M., Christensen, C. & Kagermann, H. 2008. Reinventing your business model. Harvard Business Review, 86(12): 57-68.

Kalish, S. 1985. A new product adoption model with price, advertising, and uncertainty. Management Science 31(12): 1569-1585.

Kandemir, D. & Acur, N. 2012. Examining Proactive Strategic Decision-Making Flexibility in New Product Development. Journal of Product Innovation Management 29(4): 608-622.

Karagozoglu, N. & Lindell, M. 2000. Environmental Management: Testing the Win-Win Model. Journal of Environmental Planning and Management 43(6): 817-829.

Kim, J. & Wilemon, D. 2002. Focusing on the Fuzzy Front End in New Product Development. R&D Management 32(4): 269-279.

Krishnan, V. & Ulrich, K. 2001. Product Development Decisions: A Review of the Literature. Management Science 47(19): 1-21.

Lievens, A. Moenaert, R. 2000. New Service Teams as Information-Processing Systems: Reducing Innovative Uncertainty. Journal of Service Research 3(1): 46-65.

Linder, J. & Cantrell, S. 2000. Changing Business Models: Surveying the Landscape. Accenture Institute for Strategic Change.

Lovins L. & Cohen B. 2011. Climate Capitalism: Capitalism in the Age of Climate Change. Hill and Wang Publishers.

Magretta, J. 2002. Why Business Models Matter. Harvard Business Review, 80(5): 86-92.

Makadok, R. 2001. A pointed commentary on Priem and Butler. Academy of Management Review 26(4): 498-499.

Manzini, E. 1995. Products, services and relations for a sustainable society. Paper presented at the ‘Doors of Perception 3’ Conference, Amsterdam, the Netherlands, November 1995.

Manzini, E. & Vezzoli, C. 2003. A strategic design approach to develop sustainable product service systems: examples taken from the ‘environmentally friendly innovation’ Italian prize. Journal of Cleaner Production 11(8): 851-857.

Martinsuo, M. & Poskela, J. 2011. Use of Evaluation Criteria and Innovation Performance in the Front End of Innovation. Journal of Product Innovation Management 28: 896-914.

Maxwell, D. & van der Vorst, R. 2003. Developing Sustainable Products and Services. Journal of Cleaner Production 11: 883-895.

McKinsey Global Institute. 2012. Resource revolution: tracking the global commodity markets. Available at [http://www.mckinsey.com/insights/energy_resources_materials/resource_revolution_tracking_global_commodity_markets]. Accessed 12.3.2014.

Meier, H., Uhlmann, E. & Kortmann, D. 2005. Hybride Leistungsbündel – Nutzenorientiertes Produktverständnis durch interferierende Sach- und Dienstleistungen, wt Werstattstechnik online, year 95, H. 7/8, 2005.

Meier, H., Roy, R. & Seliger, G. 2010. Industrial Product-Service Systems – IPS^2. CIRP Annals - Manufacturing Technology 59: 607-627.

Menanteau, P. & Lefebvre, H. 2000. Competing Technologies and the Diffusion of Innovations: The Emergence of Energy-Efficient Lamps in the Residential Sector. Research Policy 29: 375-389.

Montoya-Weiss, M. & O'Driscoll, T. 2000. Applying performance support technology in the fuzzy front end. Journal of Product Innovation Management 17: 143-161.

Moorman, C. 1995. Organizational Market Information Processes: Cultural Antecedents and New Product Outcomes. Journal of Marketing Research 32(3): 318-335.

Morelli, N. 2006. Developing new product service systems (PSS): methodologies and operational tools. Journal of Cleaner Production 14(17): 1495-1501.

Mullins, W. & Sutherland, D. 1998. New product development in rapidly changing markets: An exploratory study. Journal of Product Innovation Management 15: 224–236.

Morris, M., Schindehutte, M. & Allen, J. 2005. The entrepreneur's business model: toward a unified perspective. Journal of business research, 58(6): 726-735.

Müller, P., Kebir, N., Stark, R. & Blessing, L. 2010. PSS Layer Method – Application to microenergy systems. pp. 1-24. In: Sakao, T., Lindahl, M. (Eds.), "Introduction to Product/Service-System Design", Elsevier.

Müller, P. & Stark, R. 2010. A Generic PSS Development Process Model Based on Theory and an Empirical Study. Proceedings of the International Design Conference 'Design 2010'. Dubrovnik, Croatia, May 17-20, 2010.

Nadkarni, S. & Narayanan, V. 2007. Strategic schemas, strategic flexibility, and firm performance: The moderating role of industry clockspeed. Strategic Management Journal 28(3): 243-70.

Nidumolu, R., Prahalad, C. & Rangaswami, M. 2009. Why Sustainability Is Now the Key Driver of Innovation. Harvard Business Review 87(9): 1-10.

Nijssen, E., Hillebrand, B., Vermeulen, P. & Kemp, R. 2006. Exploring product and service innovation similarities and differences. International Journal of Research in Marketing 23: 241-251.

Orsato, R. 2006. Competitive Environmental Strategies: When Does It Pay to be Green. California Management Review 48(2): 127-143.

Osterwalder, A., Pigneur, Y. & Tucci, C. 2005. Clarifying business models: Origins, present, and future of the concept. Communications of the Association for Information Systems 15(1): 1-25.

Ozer, M. 2003. Factors which influence decision making in new product evaluation. European Journal of Operational Research 163: 784-801.

Pateli, A. & Giaglis, G. (2003). A Framework For Understanding and Analysing e-Business Models. Proceedings of the Bled Electronic Commerce Conference.

Pearce, D., Markandya, A. & Barbier, E. 1989. Blueprint for a Green Economy. Earthscan, London.

Peattie, K. 1999. Trappings versus substance in the greening of marketing planning. Journal of Strategic Marketing 7: 131-148.

Perkins, W. & Rao, R. 1990. The Role of Experience in Information Use and Decision-Making by Marketing Managers. Journal of Marketing Research 27(1): 1-10.

Porter, M. 1985. Competitive Advantage. Free Press: New York.

Porter, M. & van der Linde, C. 1995. Toward a New Conception of the Environment-Competitiveness Relationship. The Journal of Economic Perspectives 9(4): 97-118.

Prahalad, C. & Hammond, A. 2002. Serving the world's poor, profitably. Harvard Business Review, 80(9): 4-11.

Pujari, D. 2006. Eco-innovation and new product development: understanding the influences on market performance. Technovation 26: 76-85.

Pujari, D., Peattie, K. & Wright, G. 2004. Organizational antecedents of environmental responsiveness in industrial new product development. Industrial Marketing Management 33: 381-391.

Rehlfeld, K., Rennings, K. & Ziegler, A. 2006. Integrated product policy and environmental product innovations: An empirical analysis. Ecological Economics 61: 91-100.

Reinhardt, F. 1998. Environmental Product Differentiation: Implications for Corporate Strategy. California Management Review 40(4): 43-73.

Reinhardt, F. 1999a. Bringing the environment down to earth. Harvard Business Review 77(4): 149-157.

Reinhardt, F. 1999b. Market Failure and the Environmental Policies of Firms. Journal of Industrial Ecology 3(1): 9-21.

Roy, R. 2000. Sustainable Product-Service Systems. Futures 32: 289-299.

Saunders, M., Lewis, P. & Thornhill, A. 2009. Research Methods For Business Students. 5th ed., Harlow, Pearson Education Limited.

Saxe, R. & Weitz, B. 1982. The SOCO Scale: A Measure of the Customer Orientation of Salespeople. Journal of Marketing Research 19(3): 343-351.

Schafer, S., Smith, H. & Linder, J. 2005. The power of business models. Business Horizons, 48(3): 199-207.

Schmidheiny, S. 1992. Changing Course: A Global Business Perspective on Development and the Environment. MIT Press: Cambridge, USA.

Shapira, Z. 1997. Introduction and Overview. In “Organizational Decision Making”, Shapira, Z. (Ed.) Cambridge, UK: Cambridge University Press.

Sharma, S. & Vredenburg, H. 1998. Proactive Corporate Environmental Strategy and the Development of Competitively Valuable Organizational Capabilities. Strategic Management Journal 19(8): 729-753.

Sharman, M., Ellington, R. & Meo, M. 1997. The next step in becoming 'green': lifecycle orientated environmental management. Business Horizons 40(3): 13-22.

Siegel, R., Hansen, S. & Pellas, L. 1995. Accelerating the commercialization of technology: commercialization through co-operation. Industrial Management & Data Systems 95(1): 18-26.

Silverman, D. 2010. Doing qualitative research: a practical handbook. 3rd ed., London: Sage Publications.

Simon, M., Poole, S., Sweatman, A., Evans, S., Bhamra, T. & McAloone, T. 2000. Environmental priorities in strategic product development. Business Strategy and the Environment 9(6): 367-377.

Stahel, W. 1994. Services and sustainability. Paper for Service Products and Sustainable Development Workshop, Delft, October 1994.

Stubbs, W. & Cocklin, C. 2008. Conceptualizing a "Sustainability Business Model". Organization & Environment 21(2): 103-127.

Surroca, J., Tribo, J. & Waddock, S. 2010. Corporate responsibility and financial performance: The role of intangible resources. Strategic Management Journal 31: 463-490.

Sustain Value. 2014. Available: [http://www.sustainvalue.eu], accessed 2.4.2014.

Swanson, D. 1995. Addressing a theoretical problem by reorienting the corporate social performance model. Academy of Management Review 20(1): 43-64.

Tischner, U., Verkuijl, M. & Tukker, A. 2002. First Draft PSS Review. SusProNet Report.

Tukker, A. 2004. Eight Types of Product-Service System: Eight Ways to Sustainability? Experiences From SusProNet. Business Strategy and the Environment 13: 246-260.

UNCED. 1992. Agenda 21: Programme of Action for Sustainable Development. United Nations Department for Sustainable Development. United Nations Department of Public Information: New York.

Van Riel, A., Lemmink, J. & Ouwersloot, H. 2004. High-Technology Service Innovation Success: A Decision-Making Perspective. Journal of Product Innovation Management 21: 348-359.

Van Riel, A. & Lievens, A. 2004. New Service Development in High-Tech Sectors: A Decision-Making Perspective. International Journal of Service Industry Management 15(1): 72-101.

Waddock, S. & Graves, S. 1997. The corporate social performance – financial performance link. Strategic Management Journal 18(4): 303-319.

Wagner, M. 2007. Empirical influence of environmental management on innovation: Evidence from Europe. Ecological Economics 66: 392-402.

WBCSD. 2002. The Business Case for Sustainable Development. WBCSD, Geneva, Switzerland.

WCED. 1987. Our Common Future. Oxford University Press: Oxford.

Weill, P., Malone, T. & Apel, T. 2011. The Business Models Investors Prefer. MIT Sloan Management Review, 52(4): 17–19.

Westerlund, M. 2009. The role of network governance in business model performance. Helsinki School of Economics Working Paper.

Wheeler, W. 1992. The revival of reverse manufacturing. Journal of Business Strategy 13(4): 8-13.

Wheelwright, S. & Clark, K. 1992. Revolutionizing Product Development: Quantum Leaps in Speed, Efficiency, and Quality. Free Press: New York.

Wood, D. 1991. Corporate social performance revisited. Academy of Management Review 16(4): 691-718.

Yin, R. 2009. Case study research: Design and methods. Thousand Oaks (California), Sage Publications.

APPENDIX

List of interviewee titles and interview durations omitted for confidentiality reasons

List of subjects covered in the interviews (in Finnish)

1. **Johdanto**

a. Tutkijoiden esittäytyminen, hankkeen esittely, lupa haastattelun nauhoittamiseen, luottamuksellisuus (aineisto vain meidän käyttöön), ”kerro omin sanoin, ei odoteta yhtiön virallisia kannanottoja”, yrityksistä ei kirjoiteta nimillä, julkaisut hyväksyttäviksi yrityksiin ennen julkaisua

2. **Haastateltavan tausta**

a. Nimi ja titteli, henkilöhistoria, vastuualue ja toimenkuva

3. **Yrityksen perustiedot**

a. Miten yrityksenne on organisoitu? (liiketoimintayksiköt, henkilömäärät jne.)
b. Millaisia tuotteita ja palveluja te myytte ja tuotatte? Mikä on palveluliiketoiminnan osuus liikevaihdosta?
c. Ketkä ovat avainasiakkaanne? Miten liikevaihto jakautuu asiakastoimialojen välillä?
d. Ketkä on tärkeimpiä kilpailijoitanne? Miten erottaudutte kilpailijoistanne?
e. Miten tuote- ja/tai palvelutarjoomaa on suunniteltu kehitettävän tulevaisuudessa?

4. **Aluksi kysymyksiä yrityksen kestävän kehityksen tilasta**

a. Mitä kestävä kehitys on teidän mielestänne? Mitä se tarkoittaa teidän yrityksessä? Onko se tärkeää teidän yrityksellenne? Miksi? Mikä on tyypillinen kestävään kehitykseen liittyvä näkökohta organisaatiossanne?
b. Missä yrityksen toiminnoissa (markkinointi, tuotanto, toimitusketju, budjetointi, jne.) kestävän kehityksen näkökulmia käsitellään?
c. Mikä on haastavinta kestävän kehityksen yhdistämisessä liiketoimintaan (kokemuksia)?
d. Mitä positiivisia ja negatiivisia vaikutuksia kestävän kehityksen mukainen ajattelutapa aiheuttaa yrityksessänne? Lyhyellä ja pitkällä aikavälillä.
e. Onko yrityksellänne määritelty tavoitteita/ erityistä strategiaa/ ohjelmia/ erityisiä prosesseja tms. kestävään kehitykseen liittyen? (Tukimateriaalin pilarikuva kestävän kehityksen määrittelyyn avuksi)
f. Onko kestävän kehityksen tavoitteita huomioitu liiketoimintamallin suunnittelussa yrityksessänne (partnereiden lisäksi esim. toimintoihin, jakelukanaviin, resursseihin, ansaintamalleihin liittyen)?

5. Verkoston analysointi ja organisointi

a. Määrittele teille tärkeimmät verkostotoimijat ja sidosryhmät – ts. mitä toimijoita tarvitaan tuotteen tai palvelun toteuttamiseksi ja sen elinkaaren aikana
b. Mikä on yrityksenne rooli tässä verkostossa?
c. Miten verkosto toimii yhdessä? Miten se on organisoitunut (esim. yksi liidaa)? Miten sitä johdetaan?
d. Onko verkostolla yhteisiä, verkostotasolla tapahtuvia prosesseja? Mitä?
e. Minkälaiset suhteet teillä on verkoston toimijoihin? Minkälaista yhteistyötä teette?
f. Tunnetaanko verkostotoimijoiden ja sidosryhmien tavoitteet ja intressit kestävän kehityksen mukaiseen toimintaan liittyen (environmental/ economic/ social)? Kuinka ne on tunnistettu?
g. Mitkä asiat ovat vaikuttaneet yhteistyökumppaneiden (esim. toimittajien) valintaan? Mihin kriteereihin valinta perustuu?
h. Miten verkostotoimijoihin ja heidän toimintaansa koskevaan päätöksentekoon pyritään vaikuttamaan? Miten verkostotoimijoiden kestävään kehitykseen liittyvään toimintaan/ päätöksentekoon/ liittyviin valintoihin vaikutetaan?
i. Miten sidosryhmiä on analysoitu? Onko sidosryhmiä priorisoitu niiden kestävän kehityksen tavoitteiden/ intressien mukaan?
j. Miten suhteita sidosryhmiin hoidetaan? Otetaanko sidosryhmiä mukaan prosesseihin/ päätöksentekoon?
k. Onko verkostossa tunnistettu ja sovittu yhteisiä strategisia kestävään kehitykseen liittyviä tavoitteita? Mitä?

6. Toiminnan arviointi ja kehittämistarpeet

a. Miten omaa toimintaa seurataan/ mitataan?
b. Miten kumppanien toimintaa seurataan/ mitataan?
    i. Arvioidaanko verkostotoimijoiden onnistumista kestävän kehityksen mukaisissa tavoitteissa?
    ii. Miten toimitaan, jos verkostokumppani ei suoriudu tehtävässään/ tavoitteiden saavuttamisessa?
c. Miten verkostossa asetettujen yhteisten tavoitteiden toteutumista seurataan?
    i. Seurataanko/ mitataanko kestävälle kehitykselle asetettujen tavoitteiden saavuttamista ja toimenpiteiden toteutumista?
    ii. Päivitetäänkö verkoston yhdessä asetettuja tavoitteita/ visiota/ suunnitelmia?
d. Arvioidaanko verkoston rakenteen ja yhteisten prosessien onnistumista?
e. Millaisia vahvuuksia ja haasteita verkostotoiminnassa on/ on ollut?
f. Miten verkostoa ja yhteistä toimintaa kehitetään? Miten verkoston toimintaa pitäisi kehittää (esim. uusia toimijoita/ sidosryhmäsuhteita)? Mitkä ovat tärkeimmät toimenpiteet, joilla verkostoon liittyvät kehittämistavoitteet saavutetaan?

7. Tuote- ja palvelukehitys

a. Millaisia menetelmiä ja prosesseja yrityksellä on tuotteiden suunnitteluun ja palveluiden suunnitteluun?
b. Miten hyvin ne toimivat? Miksi (kokemuksia)?

c. Millaista tietoa tarvitaan tuote- ja palvelukehityksen tueksi? (esim. taloudellista, teknistä, operationaalista, riskeihin ja mahdollisuuksiin liittyvää, toimitusketjuun tai osaamiseen liittyviä tietoja)
    i. Mistä tietoa saadaan/ voitaisiin saada?
    ii. Miten tietoa käytännössä hyödynnetään (kuvaile)?
d. Miten arvioitte uuden teknologian markkinapotentiaalin / yhdistätte asiakastarpeen omaan osaamiseen?
    i. Miten tunnistatte mahdolliset asiakkaat?
    ii. Miten selvitätte heidän mielikuvansa mahdollisesta tuotteesta?
    iii. Miten käyttäjät otetaan huomioon tuotesuunnittelussa?
    iv. Miten tuotteen arvo kommunikoidaan?
e. Mietitäänkö verkoston eri toimijoiden ja tuotteeseen/ palveluun liittyvien sidosryhmien tarpeita ja näkökulmia sekä kestävän kehityksen mukaisia tavoitteita jo T&K-vaiheessa (esim. liittyen materiaaleihin, jakelukanaviin, huoltopalveluihin, elinkaaren loppupään ratkaisuihin)?
f. Miten tuotteiden elinkaaren loppu otetaan huomioon tuotekehityksen eri vaiheissa? (ideaatio, markkinatutkimus, suunnittelu, testaus, liiketoimintamallin valinta, lanseeraus, elinkaaren hallinta)
g. Miten tuotteen elinkaari vaikuttaa päätöksentekoon tuotekehityksessä?

8. Käyttöomaisuuden hallinta

a. Onko yrityksellä määriteltyä käyttöomaisuuden hallinnan strategiaa tai prosessia?
    i. Miten kestävä kehitys vaikuttaa tähän strategiaan tai prosessiin?
b. Millaista tietoa hyödynnetään käyttöomaisuuden hallintaan liittyvässä päätöksenteossa? (GRI, liiketoimintatieto, asiakas tiedonlähteenä, strategia, jne)
c. Kerätäänkö laitteistosta ja infrasta tietoa/ dataa tukemaan käyttöomaisuuden hallintaan liittyvää päätöksentekoa? Millaista tietoa kerätään? Millaista tietoa tulisi kerätä?
d. Analysoidaanko laitteistosta ja infrasta saatavaa tietoa ja käytetäänkö sitä liiketoiminnan kehittämiseen?
    i. Nähdäänkö yrityksessä tarvetta tiedon analysoinnille ja hyödyntämiselle?
    ii. Onko tieto hajallaan eri järjestelmissä vai saatavilla yhdessä paikassa?
    iii. Onko tieto käytössä konsernitasolla vai operatiivisella tasolla?
e. Onko yrityksessä pohdittu tai kuvattu
    i. käyttöomaisuuden hallintaan liittyvien riskien merkittävyyttä?
    ii. käyttöomaisuuden hallintaan liittyviä rooleja ja vastuita?
    iii. käyttöomaisuuden hallinnan prosesseja ja toimintoja?
    iv. tiedonvaihtoa sidosryhmien kanssa?
    v. tiedon laadun ja saatavuuden sekä tietojohtamisen vaikutusta päätöksentekoon?
f. Onko yrityksessä määritelty
    i. laatuvaatimukset tunnistetuille tiedontarpeille?
    ii. menetelmät tiedon keräämiseen, analysointiin ja arviointiin?

9. Kestävän kehityksen arvo

a. Millainen merkitys kestävällä kehityksellä on yrityksenne tuote/palvelukehityksessä?
b. Kuinka kestävä kehitys näkyy liiketoiminnan suunnittelussa?
c. Millaisia vaikutuksia yrityksenne kestävän kehityksen mukainen toiminta on tuonut mukanaan? (ympäristö, asiakkaat, yhteiskunta, jne.)
d. Millaisia hyötyjä (positiivisia vaikutuksia) kestävän kehityksen mukainen ajattelutapa on tuonut yrityksellenne? (Eri sidosryhmien näkökulmista)
e. Millaisia haittoja (negatiivisia vaikutuksia) kestävän kehityksen mukainen ajattelutapa on tuonut yrityksellenne? Millaisia ongelmia on esiintynyt? (Eri sidosryhmien näkökulmista)
f. Kuinka kestävän kehityksen mukaisten periaatteiden noudattaminen on näkynyt yrityksen saamassa palautteessa? (positiivinen ja negatiivinen palaute) (asiakaspalaute, muut sidosryhmät)
    i. Millaista palautetta yritys on saanut (kokemuksia)?
    ii. Onko asiakaskunta muuttunut?
g. Kuvailkaa, kuinka kestävä kehitys on vaikuttanut yritykselle syntyviin kustannuksiin ja niiden muodostumiseen?
    i. Millaisia kustannuksia kestävän kehityksen periaatteet yritykselle aiheuttavat?
    ii. Kuinka kustannukset näkyvät asiakkaille ja muille sidosryhmillenne?
    iii. Oletteko kohdanneet odottamattomia kustannuksia? Millaisia?
h. Ovatko kestävän kehityksen mukaiset periaatteet näkyneet tuotteiden/palveluiden hinnoittelussa? Kuinka?
    i. Onko tämä vaikuttanut asiakkaiden toimintaan ja palautteeseen?
i. Onko yrityksen toiminnassa tai toimintaympäristössä tapahtunut muutoksia, jotka ovat vaikuttaneet yrityksen kestävän kehityksen mukaiseen toimintaan?
    i. Onko toimialalla odotettavissa muutoksia vihreän liiketoiminnan vaatimusten suhteen?

10. Tulevaisuus

a. Onko yrityksenne tyytyväinen nykyiseen kestävän kehityksen tilaan?
b. Kuinka kestävän kehityksen mukaista toimintaa voitaisiin yrityksessänne kehittää? (ympäristö, asiakkaat, yhteiskunta, jne.)
c. Kuinka näette tulevaisuudessa kestävän kehityksen olevan osa yrityksen toimintaa?
    i. Onko yrityksenne tarkoitus panostaa kestävään kehitykseen tulevaisuudessa? Kuinka?
d. Kuvailkaa hyötyjä, joita kestävä kehitys tuo/voisi tuoda tulevaisuudessa yrityksellenne?
    i. Seuraavan 5 vuoden aikana
    ii. Seuraavan 20 vuoden aikana
e. Ideoikaa tarpeita ja vaatimuksia, joita teillä on kestävän kehityksen periaatteiden osalta tulevaisuudessa?
    i. Kuinka näiden tarpeiden ja vaatimusten täyttyminen auttaa toimintaanne?
f. Millaisia työkaluja yrityksessänne käytetään kestävän kehityksen suorituskyvyn mittaamiseen ja arviointiin?
    i. Ympäristön vaikutukset
    ii. Taloudelliset vaikutukset
    iii. Sosiaaliset vaikutukset